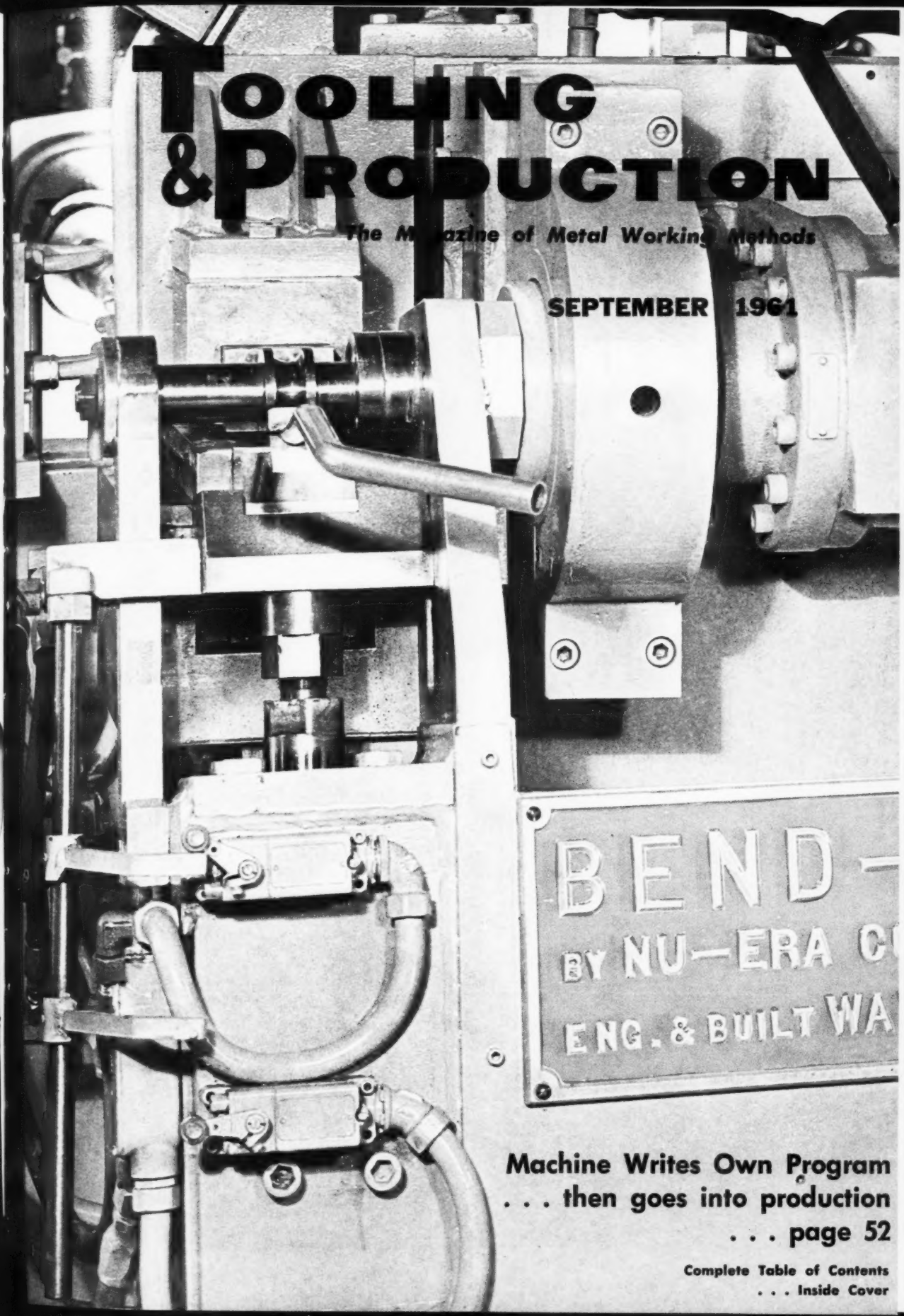
TOOLING & PRODUCTION

The Magazine of Metal Working Methods

SEPTEMBER 1961



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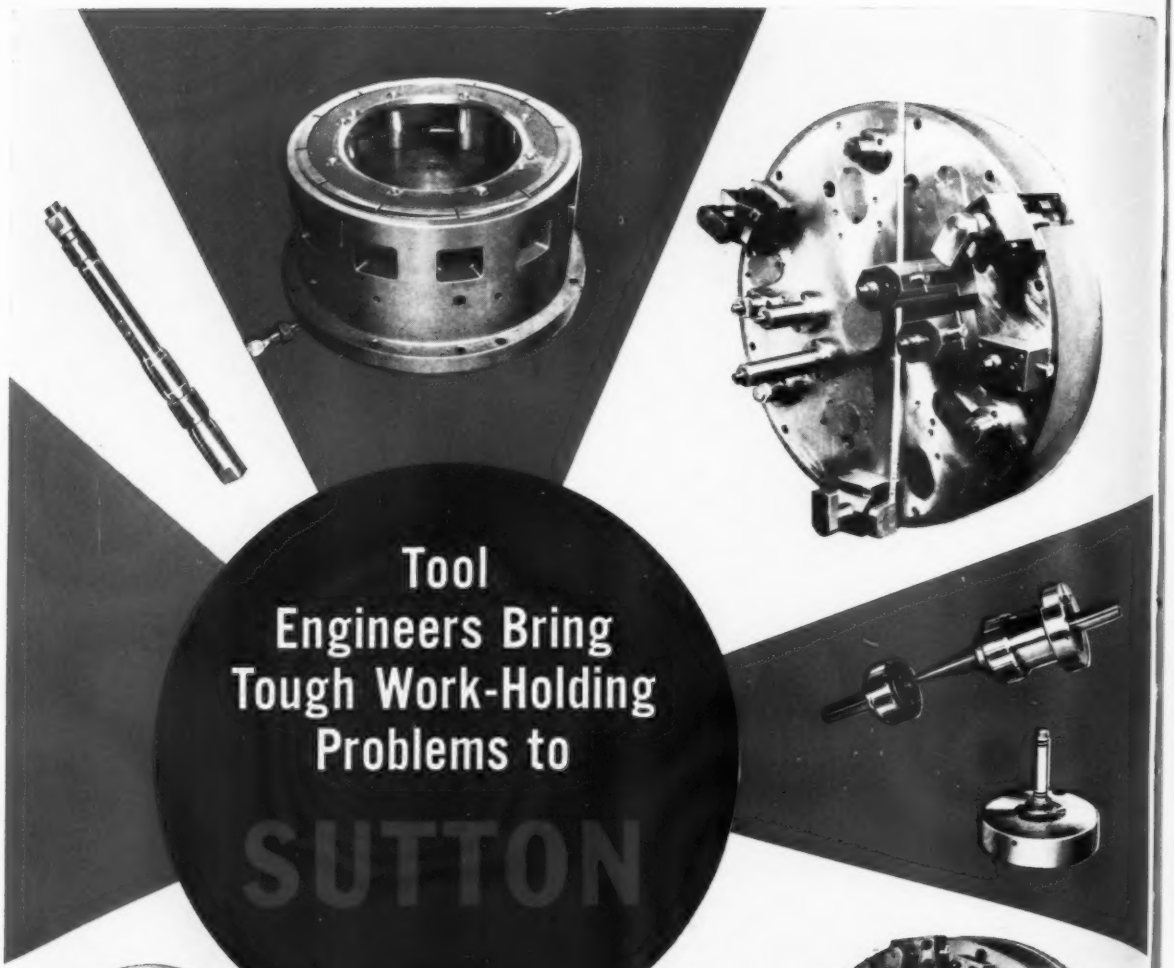
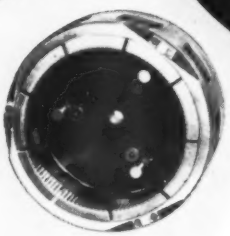


Tool Engineers Bring Tough Work-Holding Problems to SUTTON



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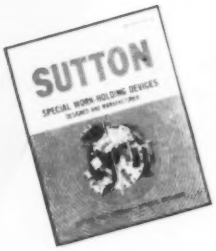

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TOOLING & PRODUCTION
The Magazine of Metal Working Methods

VOL. 27, No. 6
SEPTEMBER 1961

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TOOLING & PRODUCTION MAGAZINE

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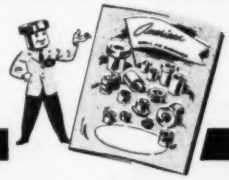

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personally speaking . . .

Dear T & P Reader:

During this year, we have been running a series of articles on the subject of machine replacement. The purpose of the series, of course, has been to provide data which would enable you to make a scientific determination as to the time when replacement of old equipment with new would be most profitable and advantageous. This series, while not directly applicable to a problem of ours, has suggested the possibility that the program we have just followed could be of interest to you.

In this business, we are greatly concerned with certain vital statistics about men and the companies for which they work. This magazine is a communications medium. Like most other publications, it stays in business through rendering service to you as a reader and to advertisers whose patronage make the existence of magazines possible.

Years ago, we began to seek more efficient ways of recording and storing information. Various methods were adopted and items of equipment acquired which together evolved improvements in our record keeping. But there always were shortcomings for the methods and equipment available. At least this was true until the combination that we now have became available.

About two years ago, we began to work with two suppliers of business machines and a program was planned for a conversion to these new types of equipment. Finally the time came for placing orders and we faced the same problems in this regard that you do when you buy equipment that can't be had from stock. We had various delivery times quoted, all the way from a few weeks to 10 to 15 months.

We now have all this equipment,—$70,000 worth of it. We have finished the back breaking job of phasing it in and training people, and we are rapidly reaching a point of doing 5 times as much work as we were previously capable of doing and at approximately the same cost.

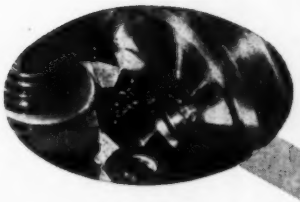
The value of the equipment for us and for our advertisers and likewise for you is enormously enhanced by your very willing and prompt cooperation in giving us, periodically, information that we need by answering verification questionnaires we send to you. The information that you give us, of course, is used only in composites and never with you identified by name.

With all of this back of us, we have asked ourselves whether we would do it again, because the conversion has given us a lot of headaches. Well, we would, but then of course if we had a second chance to do the same job, we would do it so much better, knowing what we now know, that we would sail through it with the greatest of ease. Our program has been more than a modernization program because we were modern before we started. Actually, it has been a futurization program for us. Maybe you are going through such an operation at the present time. Best of luck, if you are. I am sure the rewards will be great.

Cordially yours,

Ray Hueber

Publisher



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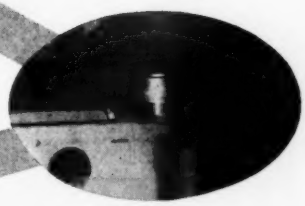
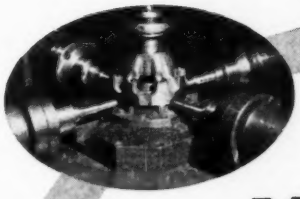
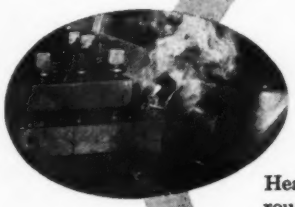


General purpose machining

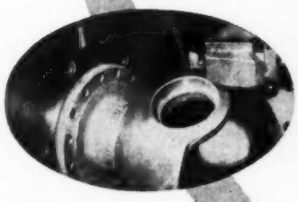


Finishing or light roughing

16 V-R carbide grades give complete machining flexibility



Heavy-duty roughing



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Talk of the Month

Challenge Of The New Age

by Dr. Simon Ramo

This article was excerpted from a talk by Dr. Ramo, executive vice president, Thompson Ramo Wooldridge Inc., before the 65th Annual Congress of American Industry, sponsored by the National Association of Manufacturers.

WE ARE IN RAPID TRANSITION to a new, highly technological society. The needs of the new age will present many challenges to the scientist and engineer. However, these challenges are nothing compared with the challenges that scientific advance will offer to society as a whole.

There is already a gross imbalance between technological and sociological progress. Will the transition to the new society be orderly or chaotic? Civilization must adapt; the impact of technology must be absorbed. We have no take-it-or-leave-it choice. The expanding, increasingly fast-pace, complex, and interacting world urgently requires solutions to the problems of its physical operations of production, communication, transportation and resources control and distribution. Because technological creativity is able to do so, it is furnishing the answers. A match between need for solutions and supply of solutions exists. Science and society are through their courtship and married.

The H-bomb is the established symbol of the growing disparity between rapid scientific change and the lagging adjustment of society. We have learned how to release quickly such tremendous amounts of energy as to destroy a civilization that has not yet produced accepted, respected conduct to preclude the use of force. But the bomb is not the best example — it emphasizes the military side of the world's problems. Even if no war or peace issue existed, disorder threatens if we fail to as-

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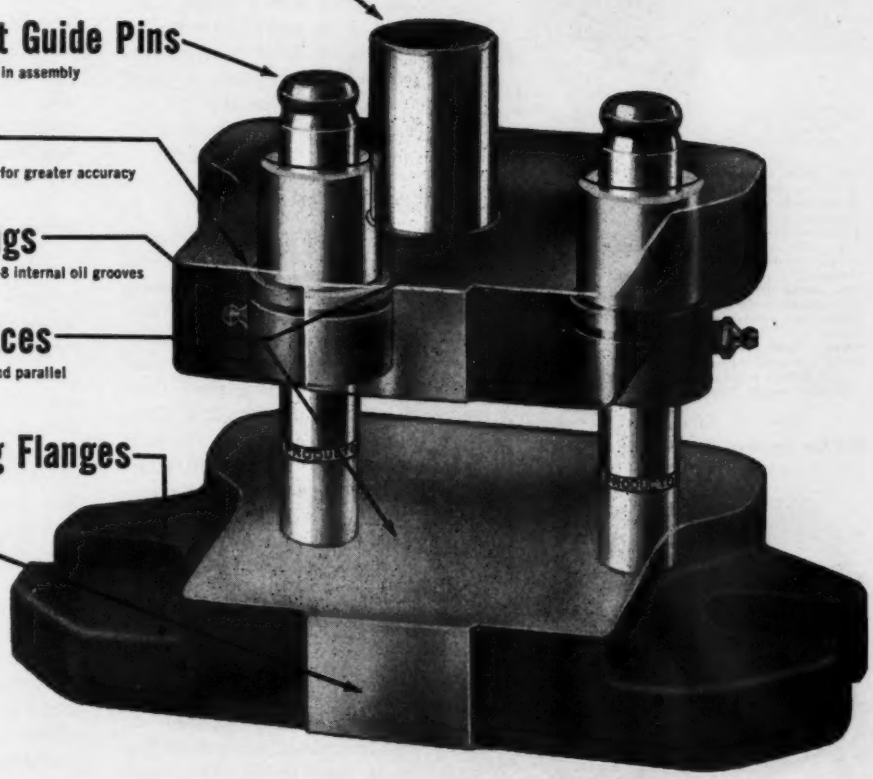

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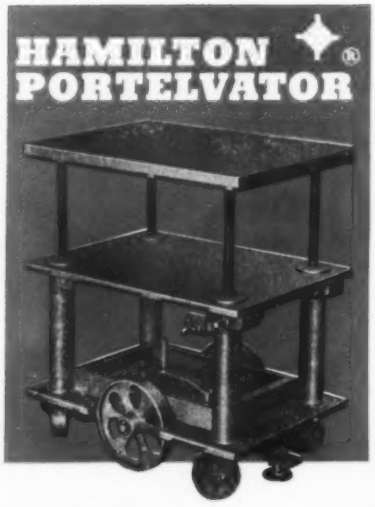

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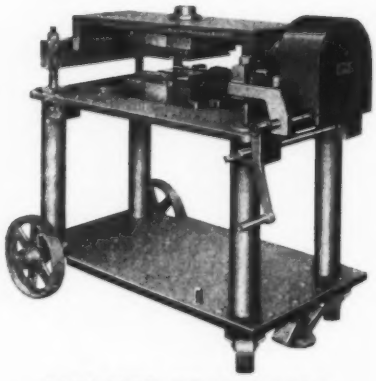

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similate the technological revolution.

Outer space is the newest symbol of the influence of technology on world affairs, and it brings us headlong into a striking array of challenges in the making of unprecedented national and international arrangements. What is the role of private, free enterprise? Where do national boundaries end? How will the world judge the contest for the limited radio spectrum as satellite repeaters make possible the wholesale interconnection of communications into a single, endless, world-wide web? What bodies and agreements will decide how space technology, meteorology, and nuclear energy will be applied, not only to predict but ultimately to influence the earth's weather?

New Way of Life

Nuclear energy developments and outer space conquest will change our way of life. So also will chemical and biological discoveries. Increased life expectancy and flights to (and even colonization of) other planets may conceivably occur before the 20th Century is over. Meanwhile, there is another area of science and technology, the extending of the human intellect and senses by application of science and technology. In every intellectual pursuit, be it in the professions, in production control, in the military, in teaching — everywhere — when we break down what we do with our minds, we find a part of this work that would be best assigned to electronic machines. So reduce the intellectual activity to the stored and the incoming information, to logical processes like sorting and deciding. The part that is well understood, that involves rates and quantities too large for the human mind, assign to the machine. This raises the human intellect to the more complex aspects of the intellectual task, above the routine work of the electronic partner.

We are speaking of a new man-machine partnership in the powerful domain of the intellect. I like the new word "intellectronics," because it "says" extending the intellect by electronics. Extending the human intellect will, in a decade or two, become our largest most significant activity.

The intellectual activity we call science and engineering has already been revolutionized by intellectronics. The intercontinental ballistic missiles, for example, would be many years away if the brains of the designers had not been extended by electronics. Thousands of flights would be needed in a clumsy, trial-and-error approach to optimizing the design. Instead, mere dozens of actual flights have been sufficient to finalize the engineering and prove out the design. The thousands of flights took place in the simulation laboratories, and the selection of the right combination of parameters out of the myriad of possibilities — too huge a task for human comparison and sorting alone — was made by a man-machine partnership.

Future Law Practice

Picture the practice of law in the technological world of a decade from now — or, at least, law as it might be practiced if technology is used to the fullest. Every practicing attorney would have in his office a convenient connection to a huge central repository of facts, rules, procedures, and precedents. For the routine filing of papers, records, and petitions, he would introduce his data into the intellectronics system, (a technique his legal training would include). Any conflict, omission, inconsistency, or other shortcoming of his work, and problems with the law or the existing records or the claims of another, would be automatically, instantly displayed to him. It will cover not just the few possibilities an unaided human brain might have handled given enough time — it will scan, select, reject, and present the result of the equivalent of the work of thousands of searchers covering many decades of records over the entire nation in a split second.

It elevates the lawyer's intellect to the more complex intellectual tasks, giving him better tools with which to work.

Even on the nonroutine legal processes, the attorney, in the coming intellectronic age, will be able to consult with the equivalent of a host of informed fellow attorneys. His request to the system for sim-

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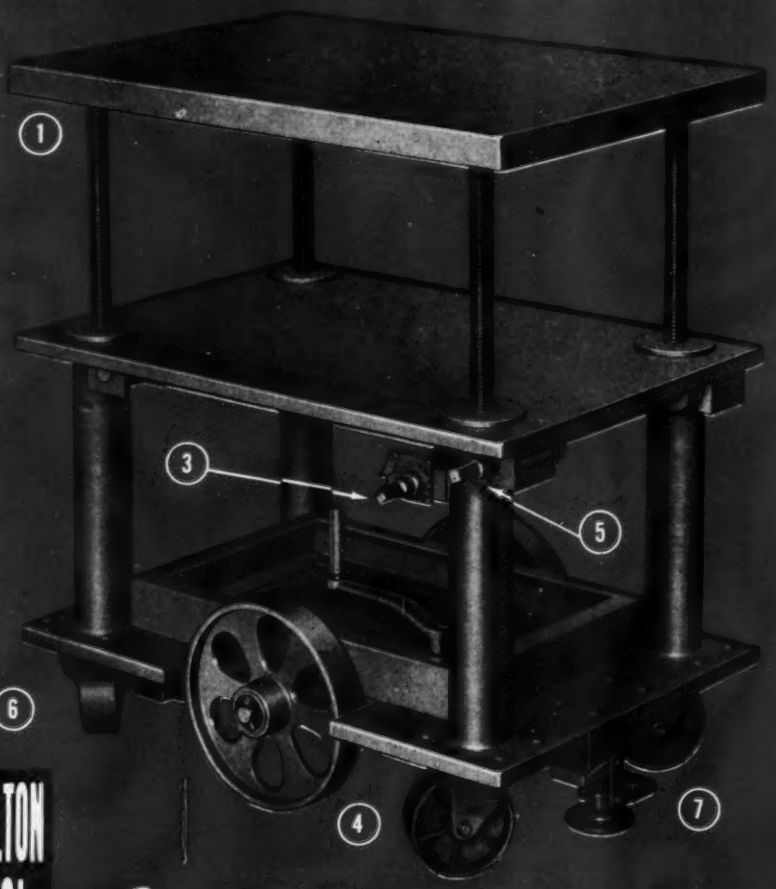

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ilar cases will yield an immediate response from the central store, together with questions and advice filed by other attorneys on those similar cases — even as he will add his facts and guidance into the system for future use by all.

Partnership Concept

This concept of man-machine partnership on difficult intellectual tasks is made clearer by considering the physician's approach in the latter part of the century. He also will routinely introduce his data on a given patient to the network of "consultative wisdom." The system will quickly react to give him some key portions of what would have been the results of many consultations with other physicians. It will call out questions he may not have asked himself. It will give statistical probabilities of relative effectiveness of various treatments with numerous variations to account for the corollary possibilities.

Notice that with diseases—their symptoms, characteristics, treatments—all nationally monitored, the statistical approach to medical practice takes on an entirely new stature. New branches of medicine will emerge based on the practical possibility of studying cause and effect on a large scale, yet rapid, basis with detailed up-to-the-minute facts on the relationship of ailment to treatment covering many thousands of cases.

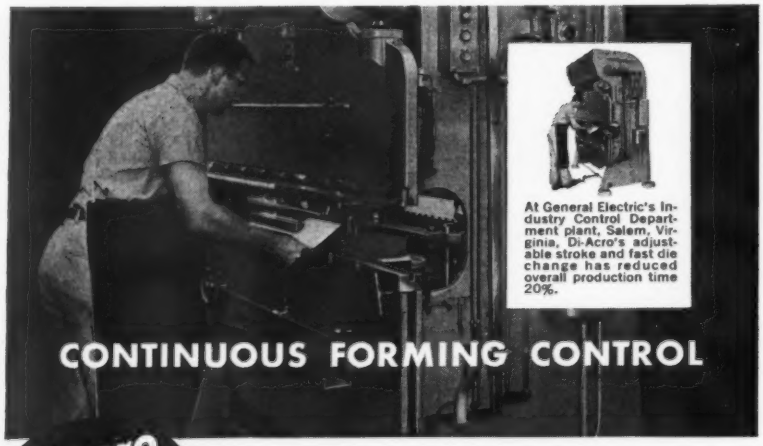
Hardly a better example can be found of the urgent need for the man-machine partnership than the control of things moving in the sky and on the ground. For safety and reliability, at the airports, in the airways, and on our surface freeways, and streets, it is clear that human brains unaided (whether a pilot, an airport controller, or an automobile driver) cannot integrate all the data, and process it fast enough, to make decisions leading to the safest use of the artery. Intellectronic systems are needed in which facts as to nature, quantity, rate of change, spatial spread, and interconnection of traffic are all sensed accurately and continuously over wide areas. Not only will the handling of planes and the role of the pilot be drastically changed, but also automobiles of the future will go on electronic control if directed onto crowded freeways.

Intellectual Limitations

Our factories and refineries already have begun to recognize the limitations of reliance on human intellect for control of operation. Too many things to keep track of, too rapidly changing are the situations, too much processing of facts and possibilities. Since much of the intellectual process is clear, only involving high quantities and rates, the machine partner, properly integrated, both relieves and suitably elevates the human intellect and makes for more efficiency and high profits.

We will have world-wide integration and interconnection. Many millions of human minds and their extensions, in the form of signals and data and information collection, will be connected together, often crossing national and language barriers. No wonder one of the most interesting of intellectronics areas is in machine translation of natural language.

The nature of language and its function will probably change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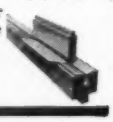
Di-Acro Rol-Form Dies eliminate work marking of highly polished or painted materials. Saves time and reduces die costs—one die does the job of many.

Consult the Yellow Pages of your telephone book under Machinery—Machine Tools for the name of your nearest Di-Acro distributor or write us.



Please Send Complete Details On:

- ☐ 25 Ton Hydraulic Press Brake
- ☐ Standard Press Brake Dies
- ☐ 12 Ton Hydraulic Press Brake
- ☐ Rol-Form Dies

DI-ACRO CORPORATION

formerly O'Neil-Irwin Mfg. Co.

949 Eighth Avenue, Lake City, Minnesota

NAME:_____

COMPANY:_____

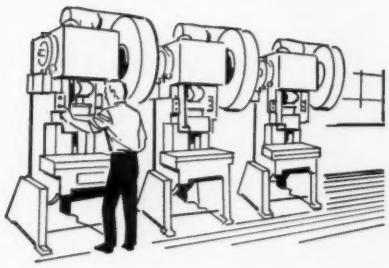
ADDRESS:_____

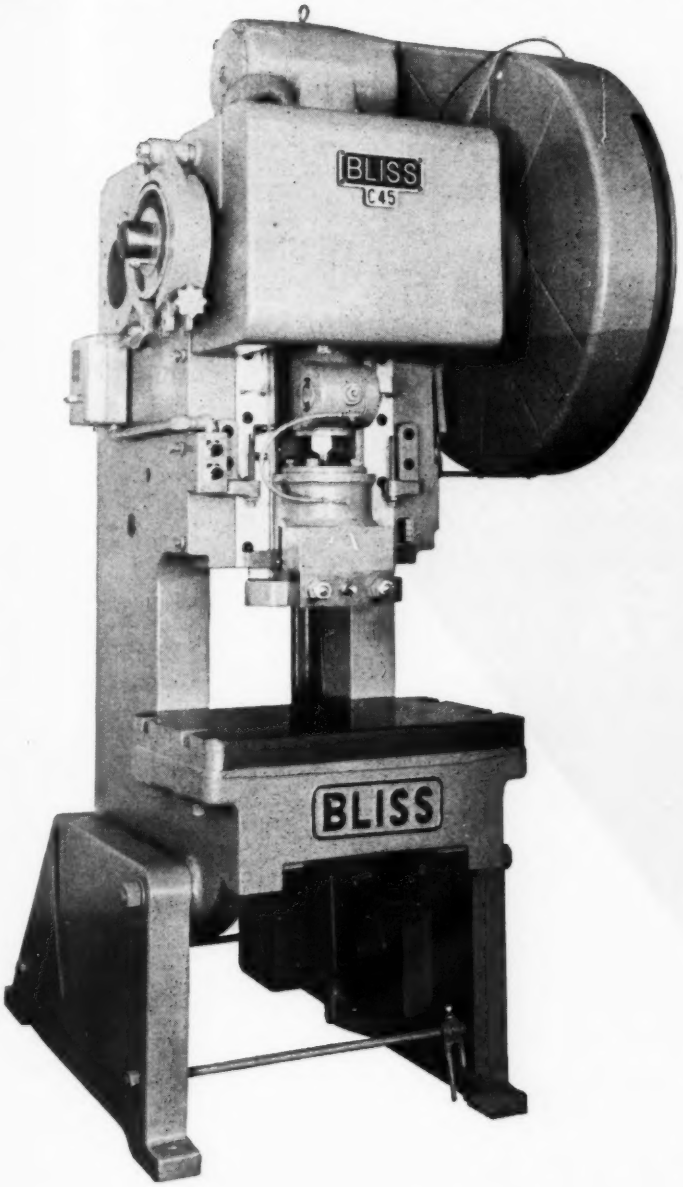
CITY:_____

STATE:_____

CIRCLE INFORM-A-GRAM KEY NO. 10

ANOTHER SATISFIED USER





LAMINA-BRONZE WEAR PLATES

Lamina
DIES AND TOOLS, INC.
P.O. BOX 31, ROYAL OAK, MICHIGAN
Phone JOrdan 6-8711

Lamina-Bronze Wear Plates and their use are more completely described in Bulletin WP-59, send for your free copy.

The ram guides of this Bliss press utilize Lamina-Bronze (electroplated bronze on steel) wear plates to assure long life and free-running. For all models in the "C" series of inclinable presses, Bliss has standardized on Lamina-Bronze V-Gibs. In like manner, Lamina-Bronze wear surfaces are the best answer for any part that requires the non-seizing properties of bronze and the strength of steel.

CIRCLE INFORM-A-GRAM KEY NO. 11

On those particularly tough jobs, there's nothing like a Danly Die Set for rugged, dependable performance. Even on longest production runs, Danly Die Sets prevent die shifting, protect dies. Turn out better, burr-free parts, too — and more of them between grinds. And with new Precision Pilot Guide Posts now available on all Danly Die Sets, assembly and dis-assembly are faster and easier than ever. If your needs demand smooth performance under most rugged conditions, depend on a Danly — either a standard or a special Danly Die Set designed to your specific requirements.

DANLY®

New literature tells how Danly's new PRECISION PILOT GUIDE POSTS assure perfect alignment for fast, easy die set assembly. Write for your copy.

Mechanical Presses, Die Sets, Diemakers' Supplies, Hydraulic Metalworking Equipment

DANLY

DANLY MACHINE SPECIALTIES, INC., 2100 South Laramie Ave., Chicago 50, Illinois

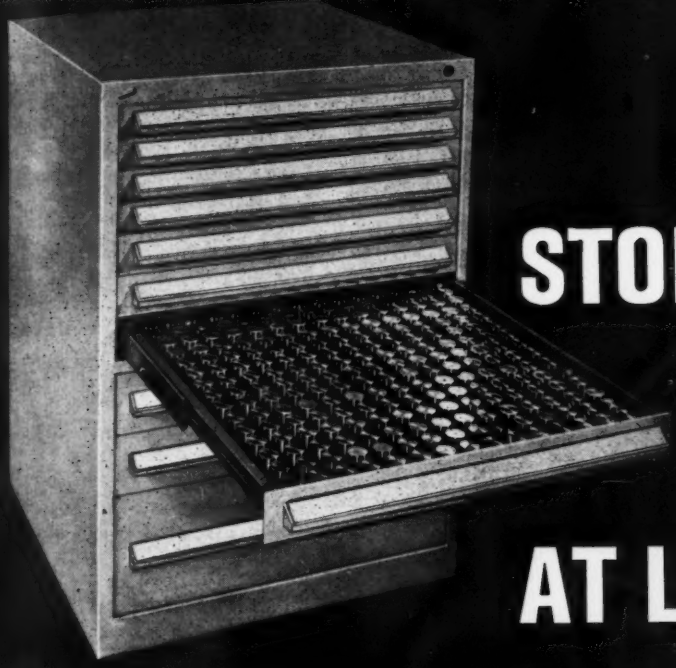
CIRCLE INFORM-A-GRAM KEY NO. 12

drastically in the years ahead. The machine partners in the universal intellectronics systems of the future will want the facts and the rules in the most efficient language possible. They will create pressure for a common, purely informational, completely logical and consistent kind of language. The technological age may force on the world a real measure of language reform or at least a new common language for some functions of human endeavor.

Education Crisis

The most truly intellectual activity of all must be the education of the brain. We are approaching a crisis in education because the needs of a more complicated, more populous world are increasing rapidly while our ability to place human resources behind the educational system is decreasing. But an intellectronics system of the future can make a ten or hundred fold change in the effectiveness of education. The routine material can be machine presented, leaving the more difficult concepts for the higher intellect of the human educator. Programmed machines can stimulate thinking, alter the presentation, speed it up, slow it down, add more explanations, skip steps — all automatically as a result of continually monitoring the student's response to questions.

These sketchy portrayals of the nature of the coming technological age should not imply that the future world will be automatic, robot-like where everyone will only be a constrained cog in a machine, without freedom of spirit and expression. On the contrary, intellectronics makes possible a degree of citizen participation in policy and goals, both discussion and decision, unthinkable today. Consider only that our Congresses, our policy bodies, could have their deliberations open to millions in their homes, and further — the added future possibility — the entire nation could vote by push-button from their homes on any issue. The result would be known to all instantly. But the future could be one in which a much greater portion of all people are up to date, understanding, interested in, and participating in determining the aims and priorities of our lives



STORE MORE, BETTER, AT LESS COST

THIS CABINET HOLDS THE ANSWER to efficient, time saving, cost-cutting storage of parts, tools, instruments, accessories and sub-assemblies . . . because . . .

SPACE IS USED TO THE MAXIMUM. Drawers can be divided into unlimited arrangements; as small as 1½" x 1½"—or larger, right up to the full 25" x 25" drawer size. And if your requirements permit . . .

A VIDMAR INSTALLATION LIKE THIS will store more, better, in less space than any other storage system available. Vidmar cabinets are designed and built expressly for industry . . . eliminate "waiting time", dirt, breakage and pilferage.

You can start your Vidmar facility with one or more cabinets. All units are modular in design—can be arranged, re-arranged, and added-to as required. Drawers are interchangeable within each cabinet or other Vidmar cabinets, and a specially designed and constructed suspension and extension system assures strength and stability. Drawers hold up to 400 lbs. each, without sagging, even when fully loaded.

Before you revise or add to your storage facilities, or plan the storage in new construction, it will pay you to look into the time- and money-saving advantages of Vidmar. Write today: Vidmar, Inc., 2326 Reach Rd., Williamsport, Pa.

Vidmar CABINETS Division of Volkert Stampings, Inc.

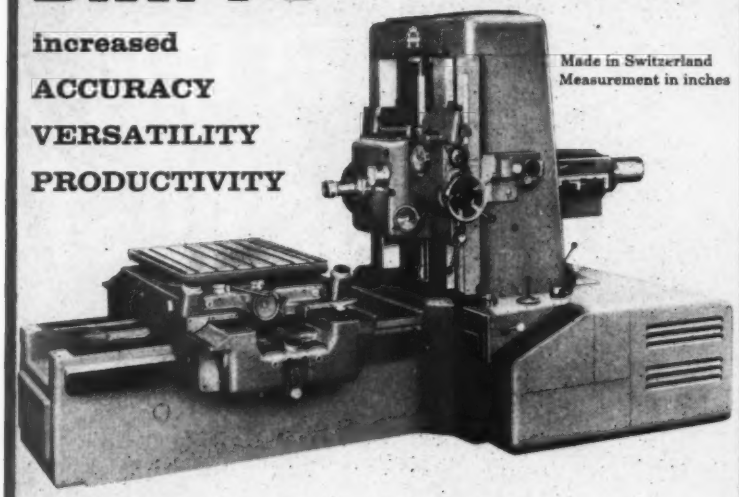
CIRCLE INFORM-A-GRAM KEY NO. 13

CUT ACCUMULATED ERRORS to a minimum

with the

DIXI 75 horizontal optical jig borer

increased
ACCURACY
VERSATILITY
PRODUCTIVITY



Made in Switzerland
Measurement in inches

- Automatic positioning can be changed instantly to manual operation
- Projected optical setting—direct reading to .00005" for linear motions and 1 sec. of arc for built-in rotary table. Linear optics provided with adjustable zero reference
- Simplified controls functionally arranged for greater operating speed and efficiency
- 3" diameter boring spindle
- Increased capacity: table size 39⅜" x 32"; 29⅝" cross travel; 23⅝" longitudinal travel; 25⅝" vertical travel
- Hydraulic feeds and infinitely variable spindle speeds
- Rear support optional

MBI has engineers available for consultation, guarantees service by factory trained staff, and stocks spare parts in New York.—Join the long list of leading aircraft and manufacturing plants throughout the United States which are using the horizontal optical jig borer.

Demonstrations upon request at our conveniently located demonstration centers.

MBI

M. B. I. EXPORT & IMPORT LTD.

475 Grand Concourse, Bronx 51, N. Y.

Swiss Accuracy plus U. S. Know-how

CIRCLE INFORM-A-GRAM KEY NO. 14

and the manner of reaching our objectives.

The brainpower of the future technological society will determine the course of the world, the stature and influence of nations. But total brainpower will be the sum of natural human intellectual activity and synthetic man-made intelligence. The machine partner will possess less mentality but will have greater capacity for the big, lower-grade load. This will give man time, the intellectual stature, and hence the inclination to solve the world's social problems. We must believe he has the inherent capability. ■

September 11-15 Instrument Society of America's 16th Annual Instrument - Automation Conference & Exhibit, Conference Sessions—Biltmore Hotel, Exhibit—Memorial Sports Arena, Los Angeles, Calif.

September 14-15 American Society of Mechanical Engineers Conference, Hotel Roosevelt, N.Y., N.Y.

September 17-21 Nonferrous Founders' Society Annual Meeting, Shawnee Inn, Shawnee-on-Delaware, Pa.

September 18-20 Standards Engineers Society Tenth Annual Meeting, Hotel Sherman, Chicago.

September 24-28 Pressed Metal Institute, Annual Meeting, Grand Hotel, Point Clear, Ala.

September 25-28 Association of Iron & Steel Engineers, Annual Convention, Penn-Sheraton Hotel, Pittsburgh, Pa.

September 25-28 American Welding Society Fall Meeting, Adolphus Hotel, Dallas, Texas.

September 28-29 National Conference and Technical Exhibit of the American Production and Inventory Control Society, Pick-Congress Hotel, Chicago, Ill.

October 4-6 American Machine Tool Distributors' Association, Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa.

WELDON *Ski-Kut* END MILLS

PATENTED

Two *Ski-Kut* styles both for ALUMINUM

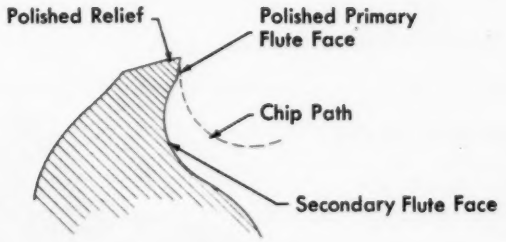
- *one for roughing*
- *one for profile finishing*

Greater feeds, longer tool life, better finish, easier operation of equipment are some of the cost-cutting benefits you get when you use Weldon's patented SKI-KUT End Mills featuring a 45° helix angle and polished chip take-off land for smoother, faster shearing action.

Series SKB — Designed for heavier stock removal, the polished primary flute face and polished relief minimize adherence of chips. Smoother shearing action minimizes the hammering effect often found in 2-flute mills with slower helix angles. Write for BULLETIN SKM-1.

Series SKX — Especially designed for profile finishing of aluminum and most non-ferrous metals. Ideal for tape-controlled and tracing machine operations, these Weldon SKX end mills provide quiet cutting and chatter-free work finishes. Write for BULLETIN SKX-10.

Weldon SKI-KUT End Mills are available from stock in ¼" to 2" diameters and various flute lengths.



OVER 40 YEARS OF LEADERSHIP SINCE 1918

Minimizes adherence of chips
Increased Shearing Action (45° helix angle)
Hammering Effect Minimized • Longer Tool Life
Greater Feeds • Better Finish • Easier Operation

THE WELDON TOOL COMPANY

3000 Woodhill Road • Cleveland 4, Ohio

Weldon Distributors throughout U.S.A. and Canada carry complete stocks to serve you.

A-5814A

CIRCLE INFORM-A-GRAM KEY NO. 15

They "Go Together" For

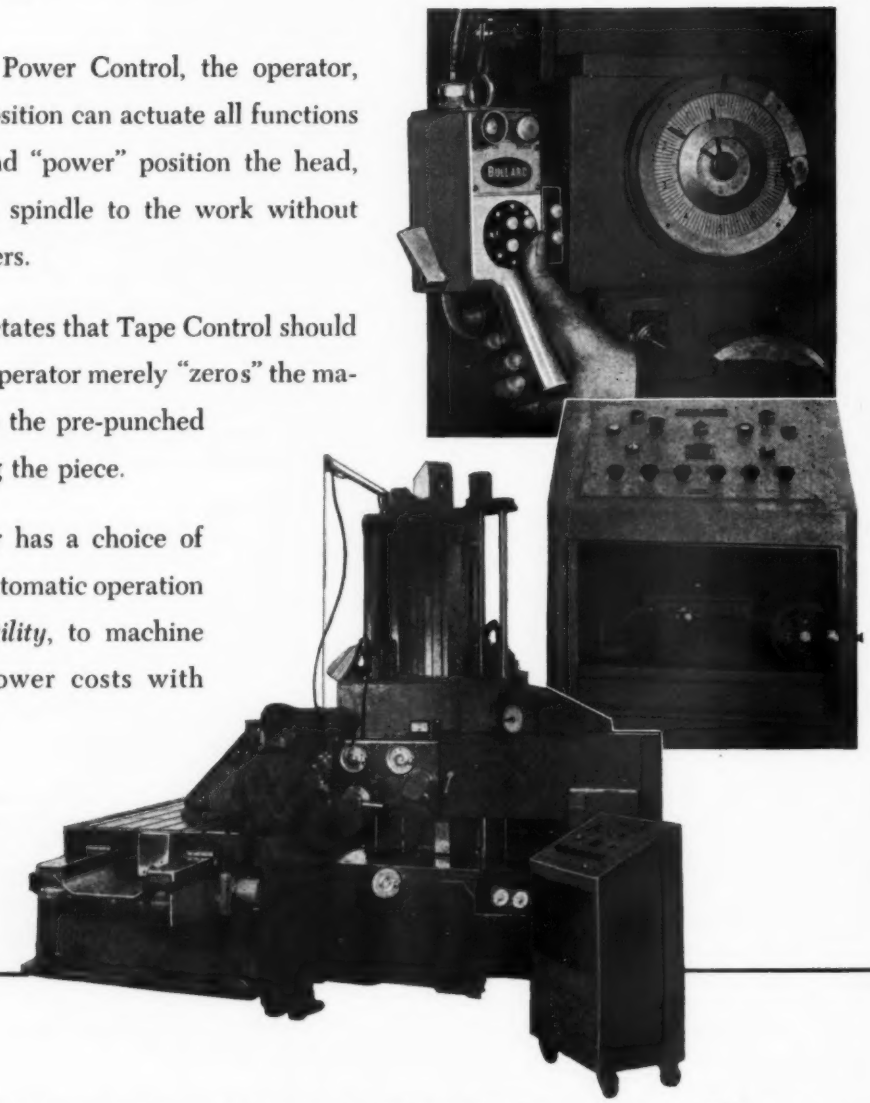
CENTRALIZED POWER CONTROL for manual operation and **NUMERICAL TAPE CONTROL** for automatic operation provide complete versatility of the Bullard DYNAMILL H.B.M. to insure maximum production.

Complete Versatility

With Centralized Power Control, the operator, from his normal position can actuate all functions of the machine and "power" position the head, table, saddle, and spindle to the work without hand cranks or levers.

When the work dictates that Tape Control should be employed, the operator merely "zeros" the machine according to the pre-punched tape for machining the piece.

Thus, the operator has a choice of either manual or automatic operation — *complete versatility*, to machine more pieces at lower costs with increased profits.



BULLARD

For Complete Information on the Bullard DYNAMILL H.B.M., call your nearest Bullard Sales Office or Distributor or write The Bullard Company, Bridgeport 9, Connecticut.

CIRCLE INFORM-A-GRAM KEY NO. 16

FROM DEVLIEG

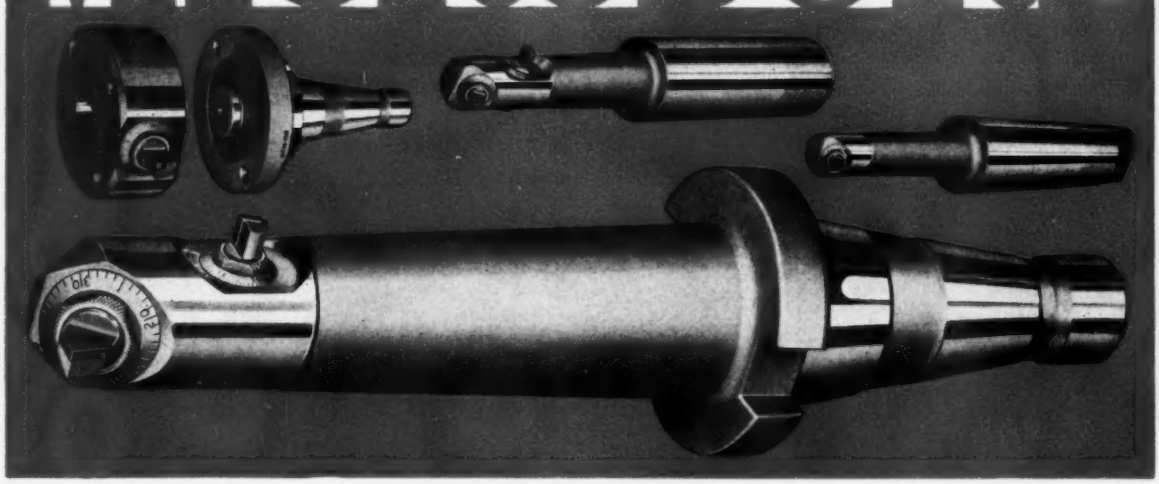
microbore®

precision

tooling

center

MICROBORE



Imitated but never equaled, MICROBORE is the single point tooling system with micrometer vernier adjustment. Designed for all boring, turning and facing operations, the basic MICROBORE system includes over 300 standard single point tools from stock with carbide, ceramic and high speed steel tips • special cluster tooling • Flash-Change tooling • adjustable blade facing heads • tooling with Kendex "throw-away" inserts. And not just a product line, MICROBORE is a complete service comprised of well schooled sales engineers, tool design engineers, highly specialized plant facilities, field service and tool maintenance. Write for complete information.

DEVLIEG MICROBORE • DIVISION OF DEVLIEG MACHINE COMPANY • FAIR STREET • ROYAL OAK, MICHIGAN

MICROBORE • PRECISION TOOLING CENTER

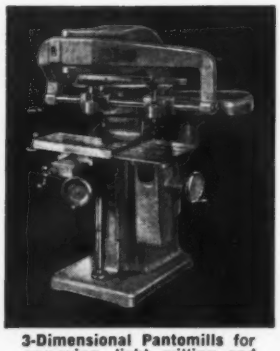
DEVLIEG MICROBORE SYSTEM

CIRCLE INFORM-A-GRAM KEY NO. 17

GORTON *THE NAME FOR PROGRESS*

STANDARD AND SPECIAL MILLING MACHINES YOUR ANSWER TO TODAY'S METALWORKING PROBLEMS!

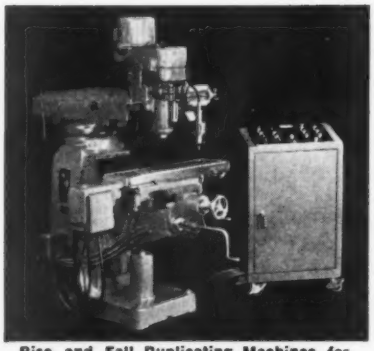
2-Dimensional Pantomills for engraving and light milling —3 sizes.



3-Dimensional Pantomills for engraving, light milling and duplicating — 2 sizes.

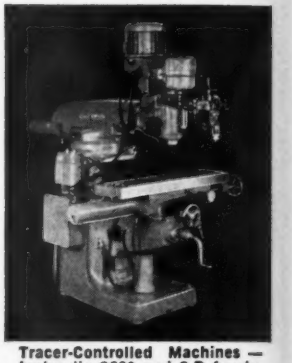
Geared-Head Milling Machines — horizontal, universal and vertical — No. 2 and No. 3-sizes. Toolroom accuracy.

Belt-Driven Milling Machines —vertical and turret types— 3 sizes, 2 h.p. through 5 h.p.

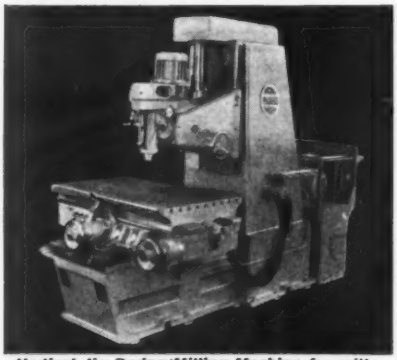


Rise and Fall Duplicating Machines for mold and die applications — 2 sizes through 5 h.p. Completely automatic — ruggedly built — extremely sensitive.

Automatic Profiling Machines for production operations — 2 sizes through 5 h.p. Twin spindles and special design—rugged — sensitive.



Tracer-Controlled Machines — hydraulic 360° and 3-D for duplicating and profiling—single or multiple-spindle models.



Vertical Jig Boring/Milling Machine for milling, drilling and boring. Large capacity — optical system — infinitely variable speed and feed rates.

THE GORTON LINE

From pantomills to transfer machines, Gorton through imaginative design provides the user with advanced methods. Real savings in time and money are accomplished with standard or special-purpose machines with manual, semi-automatic or automatic controls. Complete line of small tools and accessories available. Write for literature about Gorton equipment which will help solve your metalworking problems.

Numerical Control Double-Column Rail Mill — specifically designed and built for numerical control. Positioning and continuous path systems.

A Gorton Product, the Finest of Its Kind!

GORTON

SINCE 1893

GEORGE GORTON MACHINE CO.

1209 RACINE STREET, RACINE, WISCONSIN

Milling, Die Sinking, Profiling and Engraving Machines with Manual Hydraulic, Electro-Hydraulic or Numerical Guidance Systems. Special Machines and Automated Transfer or Indexing Machines. Cutting Tools and accessories...Defense and special products.

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Harig

The most complete source for

* CARBIDE DIES
* STEEL DIES

BEFORE YOU RE-TOOL, we strongly urge you to make use of our Customer Consulting Service for recommendations as to what type of die would be best for your application. A typical example is the way more and more manufacturers are turning to Harig Carbide Dies because of the tremendous cost-saving advantages resulting from less downtime—longer runs—lower maintenance.

Harig's many years of experience and know-how in engineering and building dies is at your service—from the simplest to the most complicated designs, of carbide or steel. Phone or write us today and a Harig engineer will be happy to call at your plant, at your convenience.

NEW HARIG BROCHURE

...loaded with information on Harig carbide and steel dies, photos of plant facilities, charts, etc.

JUST WRITE, "SEND HARIG BROCHURE" ON YOUR LETTERHEAD

Harig MANUFACTURING CORP.
5761 W. Howard Street • Chicago 48, Ill.

Products by Harig Machine Tool Division

HARIG 612 SURFACE GRINDER

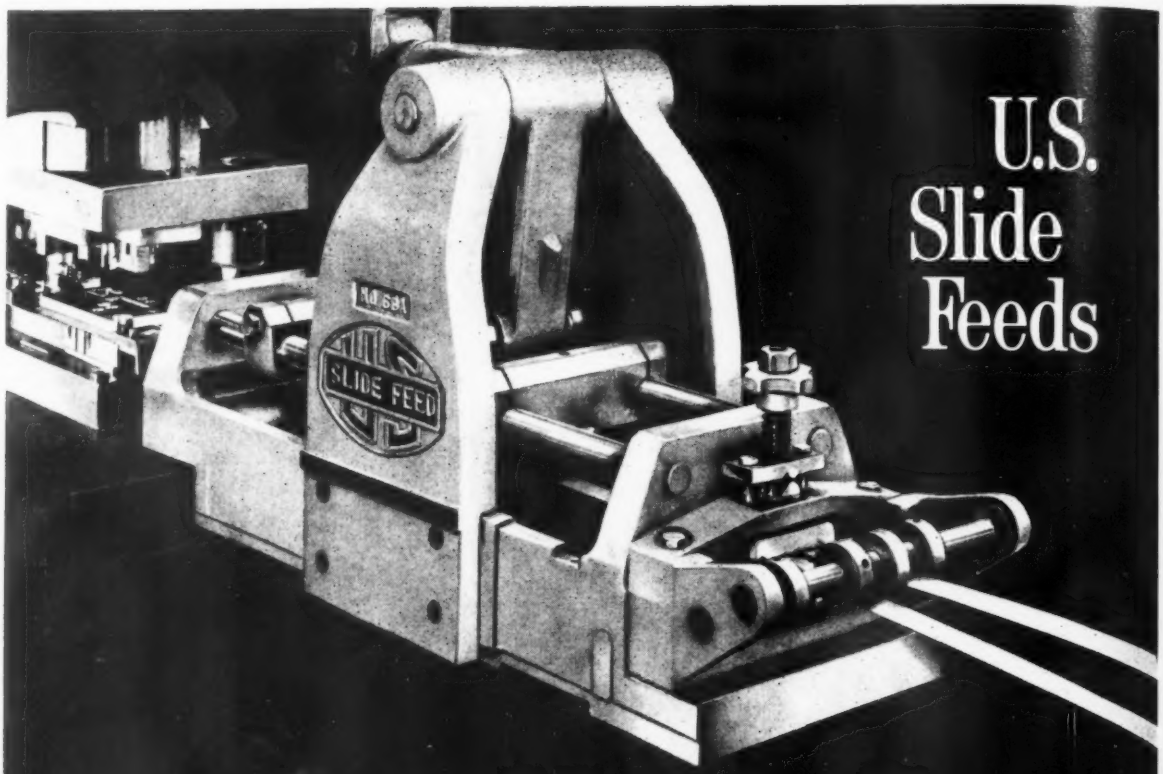
GRIND-ALL FIXTURE

VISES

RELIEF-GRINDING FIXTURE

AIR-FLO FIXTURE

CIRCLE INFORM-A-GRAM KEY NO. 19

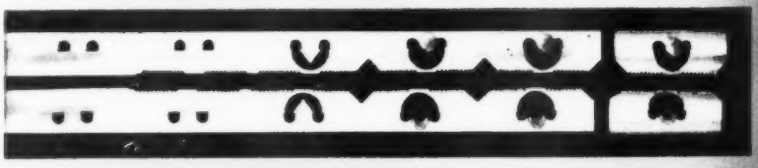


U.S. Slide Feeds

multiple feeding cuts stamping costs

Coil stock of regular and irregular profile can be fed singly or in multiples of two or more strips, accurately and at high speeds by U.S. Slide Feeds. Metal, plastic, wire, paper and fibre are fed with equal facility.

G. & A. Machine Works, New York, N. Y. has produced more than one hundred million webbing clips with the U.S. Slide Feed illustrated.



Two strips of 19 gauge cold rolled steel, ¾" wide are fed simultaneously into a 6 station scrapless die. Pilots are not used. A Model 68-A, U.S. Slide Feed and Stock Drag, arranged for multiple feeding produces 120,000 perfect parts per 8 hour day.

Send us specifications of the parts you are now running, or considering. Our developments in press feeding equipment and techniques may provide a means to important savings. Your inquiries will receive prompt attention.

US PRODUCTS

Dept. P, AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

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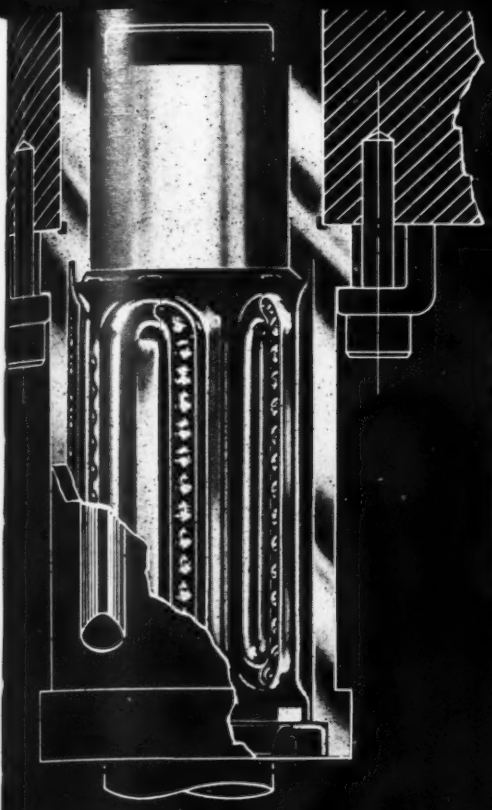
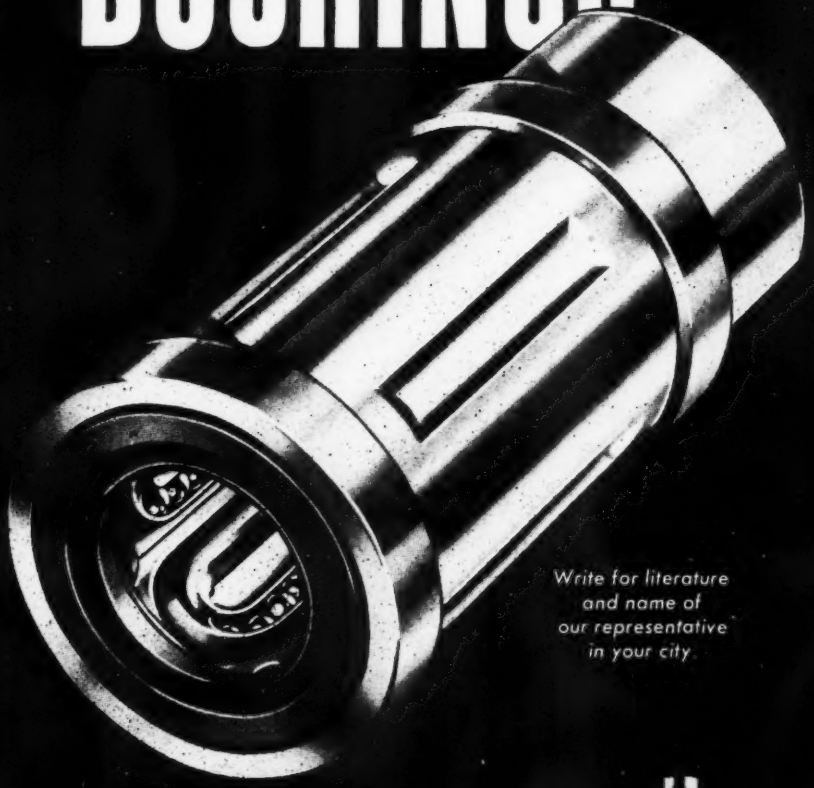
CIRCLE INFORM-A-GRAM KEY NO. 21



THOMSON INTERCHANGEABLE die-set BALL BUSHINGS®

NEW!

GO ANTI-FRICTION
with a simple bushing replacement
and (1) Improve performance of your *present* dies
and (2) Reduce tool room costs



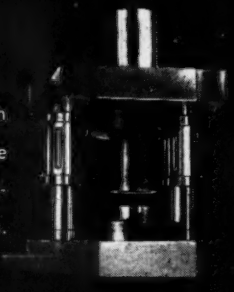
Write for literature and name of our representative in your city.

in the PRESS ROOM

Ball Bushings allow closer fits and maintain alignment which increases die life and permits longer uninterrupted runs. Fewer sharpenings and sustained parts accuracy also result. Periodic lubrication is eliminated and higher speeds are possible. Unlimited travel permits die to be used in any press regardless of stroke. Costly smash-ups due to seizure are eliminated.

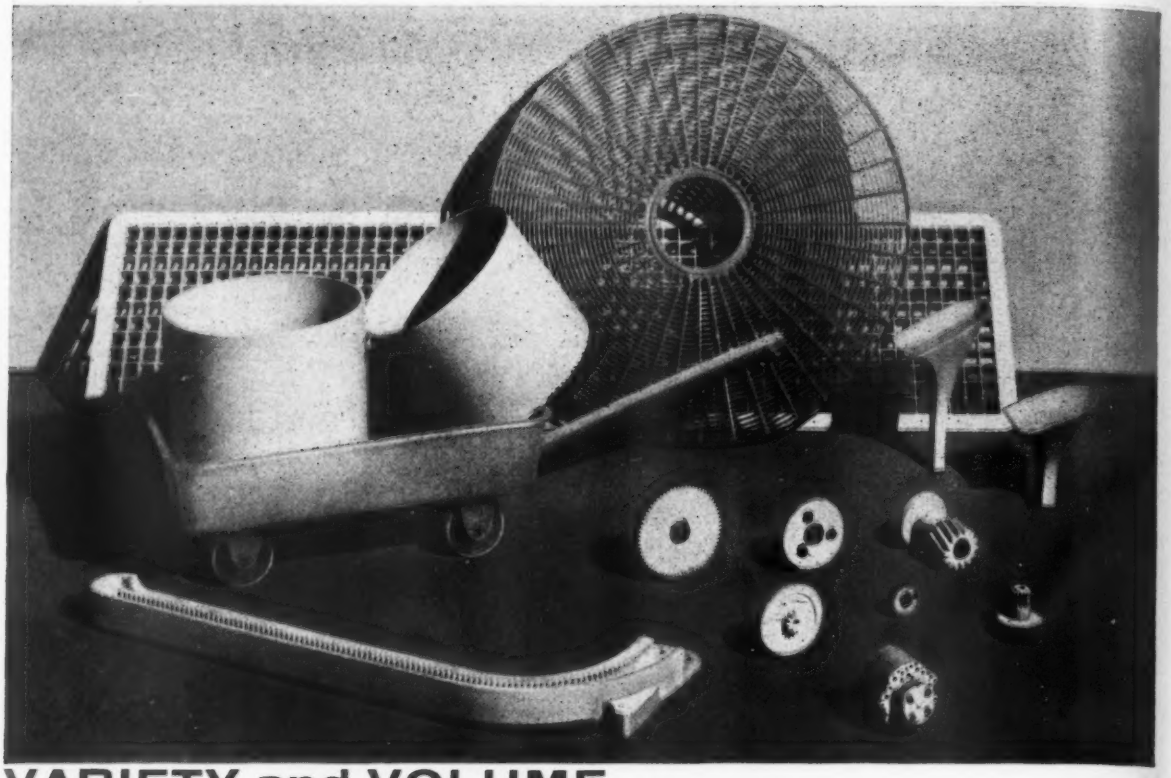
in the TOOL ROOM

No cocking and binding...hence the punch holder "floats" on and off! No time consuming die jacking! Free-rolling *ball* bearings enable the toolmaker to actually "feel in" the fit of mating parts. This saves more time and makes better dies.



THOMSON INDUSTRIES, Inc.
Dept. D-5, MANHASSET, NEW YORK

Makers of 60 Case hardened & ground shafting and NYLINED Bearings...Sleeve Bearings of DuPont NYLON

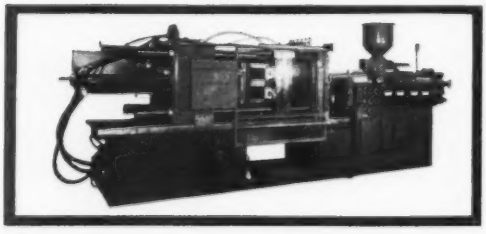


VARIETY and VOLUME . . .
More Profitable on a FELLOWS

Whatever the size, shape, or material you're running, you can produce faster, and with fewer rejects, on a FELLOWS.

Now, five advanced, high-precision FELLOWS Injection Molding Machines provide standard shot capacities from 3 ozs. to 20 ozs. And the new FELLOWS Transfer Injector Unit extends this range to 50 ozs. (See shot capacities below).

Built-in controls permit easy set-ups, one operator can easily handle two or more machines. And a wide variety of optional attachments provides automatic production of pieces with threads, undercuts, side cores, and other "hard-to-mold" characteristics. Ask your FELLOWS Plastics Specialist for full details.



MODEL	3-125	6-200	6-10-225*	12-350*	12-450*
Rated Capacity (ozs.)	3-4.5	6-9	6-10	12-20	12-20
Max. Mold Size	12″ x 17″	15″ x 21″	15″ x 25″	20″ x 33″	27″ x 34″
Mold Locking Force (tons)	125	200	225	350	450
Mold Opens	5″-8″	6″-9″	8″-14½″	10″-20″	10″-20″
Dry Cycles (per hr.)	600-840	490-650	900-1050	600-800	600-800
Horsepower	15	20	30	40	40
KW Heater Unit	6	12	13	21	21½
Plasticizing lbs. per hr.	45	75	100	150	150

*Shot Capacities with Transfer Injector: Model 6-10-225 . . . 25 ozs.; Models 12-350 and 12-450 . . . 50 ozs.

THE FELLOWS GEAR SHAPER COMPANY
Plastics Machine Division:
Head Office and Export Department, Springfield, Vermont.
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

SOCIETY OF THE PLASTICS INDUSTRY

Fellows
injection molding equipment

CIRCLE INFORM-A-GRAM KEY NO. 22

IT'S A FACT!

DRILLHEADS
ARE OBVIOUS.

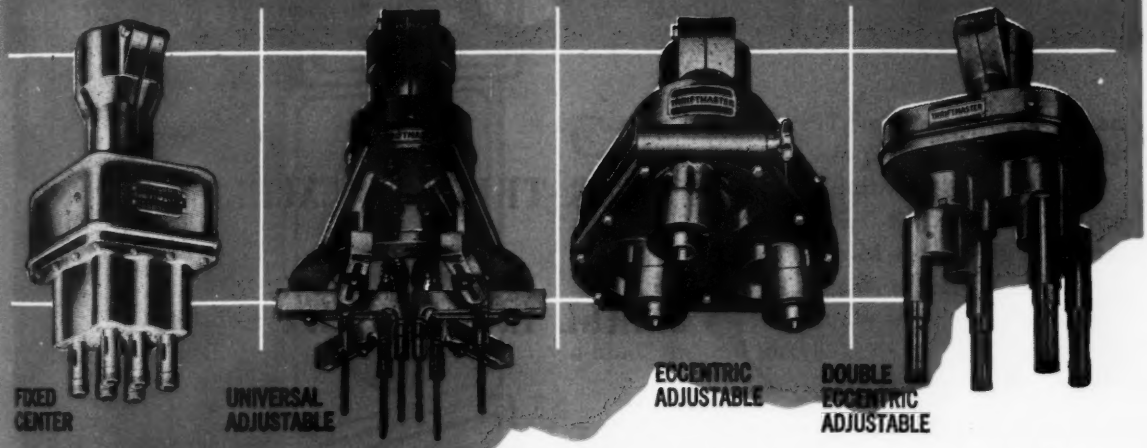
Tremendous economies from the use of multiple-spindle drillheads are obvious. Drilling one hole at a time cannot be tolerated in this day of automation!

THOMSON
THRIFTMASTER
Drillheads
are your best Drillhead buy...

1. They are better built and cost no more (Full ball bearing construction, hardened gears, spindles and driver, and precision grinding!)
2. This means they last longer
3. This eliminates down time
4. This eliminates production losses
5. This drastically reduces drilling costs

THOMSON
THRIFTMASTER

Drillheads are designed and produced by engineers whose experience **in this specific field** dates back to 1923. This long accumulation of engineering technique and production "know-how" is reflected in our product—**a quality tool... solid, substantial and dependable!**



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THRIFTMASTER
PRODUCTS CORPORATION

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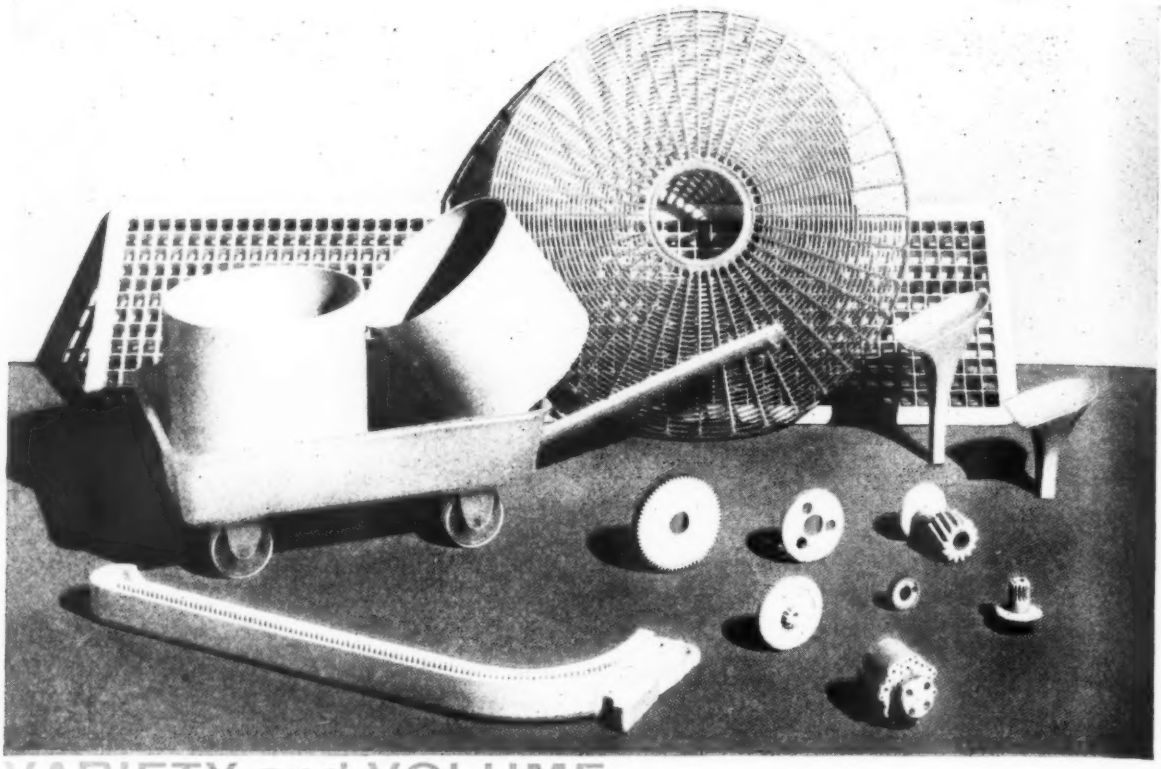
LANCASTER, PENNSYLVANIA
Phone EXpress 2-2101

Also Makers of DORMAN AUTOMATIC REVERSE TAPPERS

DRILL • TAP
REAM • BORE
COUNTER-BORE
COUNTER-SINK
FACE... with
THRIFTMASTER

Subsidiary of
THOMSON INDUSTRIES, INC.
makers of BALL BUSHINGS • NYLINERS • 60 Case Shafting

CIRCLE INFORM-A-GRAM KEY NO. 23



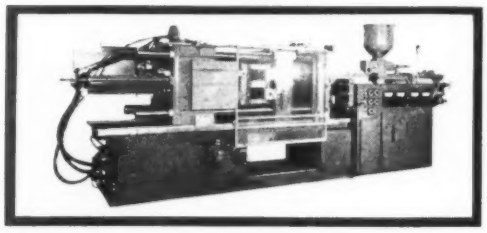
VARIETY and VOLUME . . .

More Profitable on a FELLOWS

Whatever the size, shape, or material you're running, you can produce faster, and with fewer rejects, on a FELLOWS.

Now, five advanced, high-precision FELLOWS Injection Molding Machines provide standard shot capacities from 3 ozs. to 20 ozs. And the new FELLOWS Transfer Injector Unit extends this range to 50 ozs. (See shot capacities below).

Built-in controls permit easy set-ups, one operator can easily handle two or more machines. And a wide variety of optional attachments provides automatic production of pieces with threads, undercuts, side cores, and other "hard-to-mold" characteristics. Ask your FELLOWS Plastics Specialist for full details.



MODEL	3-125	6-200	6-10-225*	12-350*	12-450*
Rated Capacity (ozs.)	3-4.5	6-9	6-10	12-20	12-20
Max. Mold Size	12″ x 17″	15″ x 21″	15″ x 25″	20″ x 33″	27″ x 34″
Mold Locking Force (tons)	125	200	225	350	450
Mold Opens	5″-8″	6″-9″	8″-14½″	10″-20″	10″-20″
Dry Cycles (per hr.)	600-840	490-650	900-1050	600-800	600-800
Horsepower	15	20	30	40	40
KW Heater Unit	6	12	13	21	21½
Plasticizing lbs. per hr.	45	75	100	150	150

*Shot Capacities with Transfer Injector: Model 6-10-225 . . . 25 ozs.; Models 12-350 and 12-450 . . . 50 ozs.

THE FELLOWS GEAR SHAPER COMPANY
Plastics Machine Division:
Head Office and Export Department, Springfield, Vermont.
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

Fellows

injection molding equipment

CIRCLE INFORM-A-GRAM KEY NO. 22

IT'S A FACT!

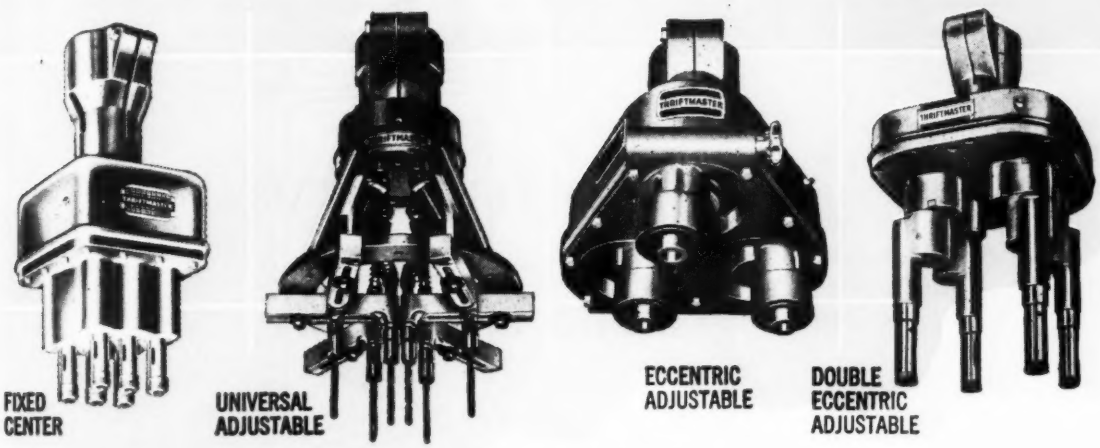
THRIFTMASTER DRILLHEADS ARE OBVIOUS.

Tremendous economies from the use of multiple-spindle drillheads are obvious. Drilling one hole at a time cannot be tolerated in this day of automation!

THOMSON THRIFTMASTER Drillheads are your best Drillhead buy...

1. They are better built and cost no more (Full ball bearing construction, hardened gears, spindles and driver, and precision grinding!)
2. This means they last longer
3. This eliminates down time
4. This eliminates production losses
5. This drastically reduces drilling costs

THOMSON THRIFTMASTER Drillheads are designed and produced by engineers whose experience **in this specific field** dates back to 1923. This long accumulation of engineering technique and production "know-how" is reflected in our product—**a quality tool... solid, substantial and dependable!**



FIXED CENTER

UNIVERSAL ADJUSTABLE

ECCENTRIC ADJUSTABLE

DOUBLE ECCENTRIC ADJUSTABLE

DRILL • TAP
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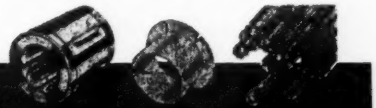
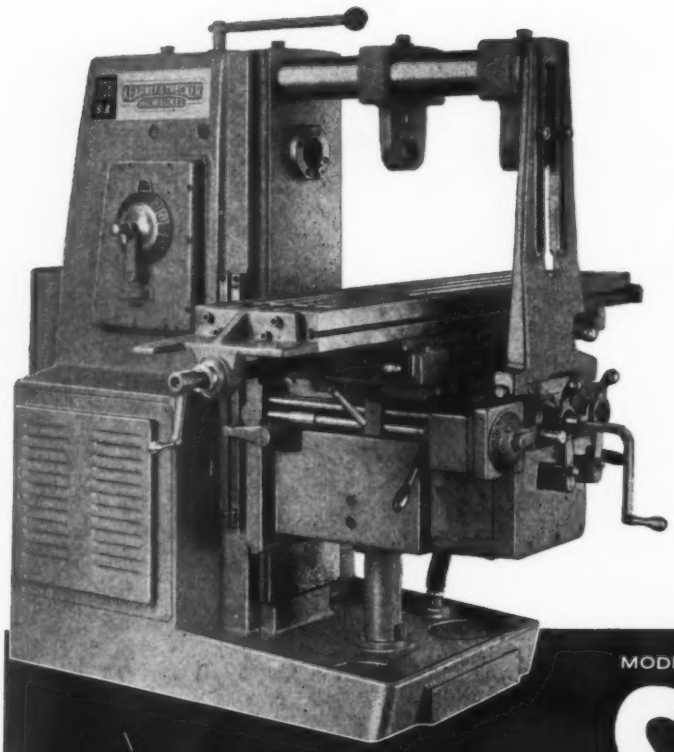


Subsidiary of
THOMSON INDUSTRIES, INC.
—makers of BALL BUSHINGS • NYLINERS • 60 Case Shafting

CIRCLE INFORM-A-GRAM KEY NO. 23



Announcing

the ALL NEW

MODEL **SA** 5hp **KNEE TYPE** MILLING MACHINES

KEARNEY & TRECKER EXCELLENCE

SMALL INVESTMENT

We'll mail a copy of Bulletin SA-61 immediately upon receipt of your request.

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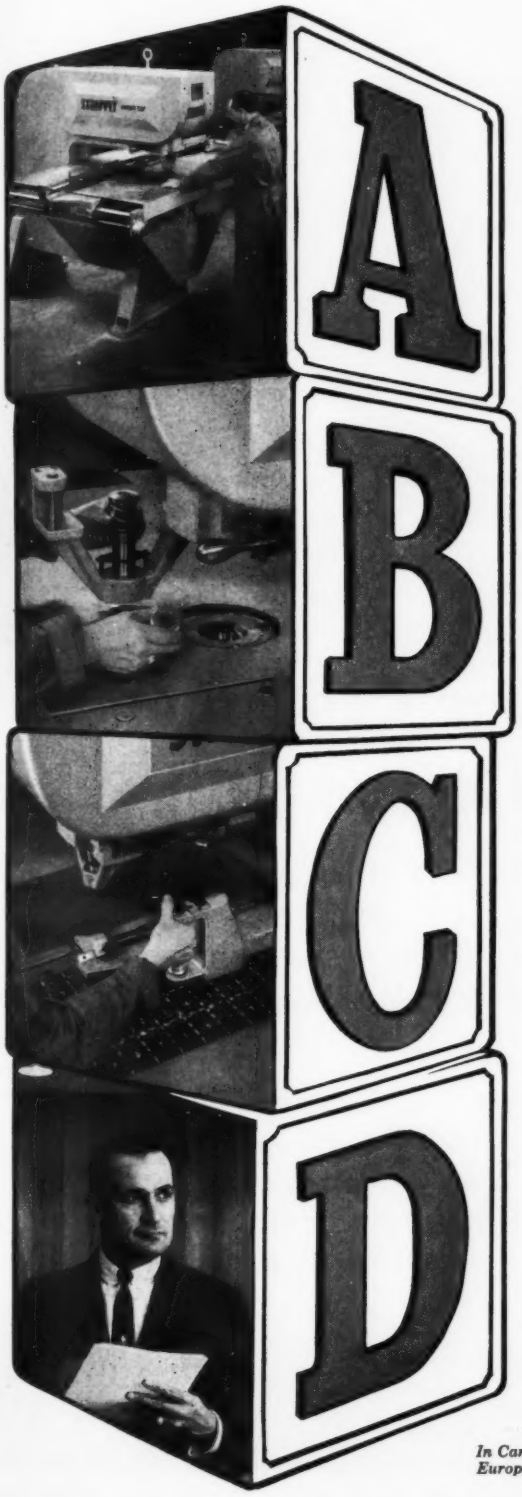
6800 West National Avenue • Milwaukee 14, Wisconsin, U.S.A.
Phone GReenfield 6-8300 . . . Direct Distance Dialing Code No. 414

BUILD A BETTER PRODUCT WITH STRIPPIT SUPER 30 FABRICATOR



A versatile, multi-purpose, single station sheet metalworking machine, the STRIPPIT Super 30 Fabricator punches round and shaped holes in workpieces up to 60" wide...any length. Will also punch close-centered hole clusters in any material up to ¼" thick... nibbles straight or contour lines in ⅛" material...notches 90° corners, radii and special edge notches to meet most production requirements in material up to ⅛" thick.

Big savings in time are standard! Change tools in *seconds!* STRIPPIT's Swing-Shift Punch Holders permit you to change punches from either right or left. One size punch and die can be substituted for another in 20 seconds. Workpieces can be positioned rapidly for precise hole location thanks to STRIPPIT'S Micrometric Back and End Gaging System. Set dimensions directly to thousandths.

Convert the STRIPPIT Super 30 Fabricator to an efficient medium run production unit simply by adding our Duplicator attachment. Another useful accessory is our Dupl-O-Scope, a high quality optical instrument designed specifically for translating blueprints, drawings, negatives, layouts or sample parts into accurate templates or "one-of-a-kind" finished pieces.

Don't hesitate to call your STRIPPIT Tool & Methods Engineer. He can arrange a demonstration at your plant that will show you ways to cut costs with the STRIPPIT Super 30 Fabricator or other STRIPPIT machines and systems. Write for Catalog 30S.

WALES **STRIPPIT** INC.

212 Buell Road Akron, New York

In Canada: Strippit Tool & Machine Company, Brampton, Ontario; In Continental Europe: Raskin, S. A., Lausanne, Switzerland; In the British Isles: Kearney & Trecker—C.V.A. Ltd., Hove, Sussex England.

CIRCLE INFORM-A-GRAM KEY NO. 25

The NILSON Combination Press and FOURSLIDE Forming Machine comes in seven models with press capacities from 5 to 75 Tons.

Part formed in one operation in a FOURSLIDE.

Competitive Pressrooms Can Produce and Earn More—with a Nilson FOURSLIDE

The NILSON machine, which combines a crank or toggle press with FOURSLIDE forming motions, produces complex stampings in one operation. Standard NILSON FOURSLIDES incorporate built-in stock straightening and feeding mechanisms, together with cam-actuated horizontal and vertical motions, providing many production advantages:

- **Eliminate expensive camming and tooling**
- **Reduce material costs—no carrier for metal strip**
- **High production rates—up to 200 parts/minute**
- **Quick-change cams for fast changeover**
- **Utilizes lower cost adjustable form tools and dies for multiple sizes**
- **Automatic scrap disposal in the horizontal press**
- **Additional motions readily available from four camshafts**
- **Also handles wire forms requiring press operations**
- **Forms wide range of part sizes—up to 4" wide; 16" long**
- **Forms on two levels, and minimizes stripping problems**

NILSON

Full explanation of the NILSON FOURSLIDE PROCESS is available in the "FOURSLIDE Design & Tooling Handbook", which is yours for the asking.

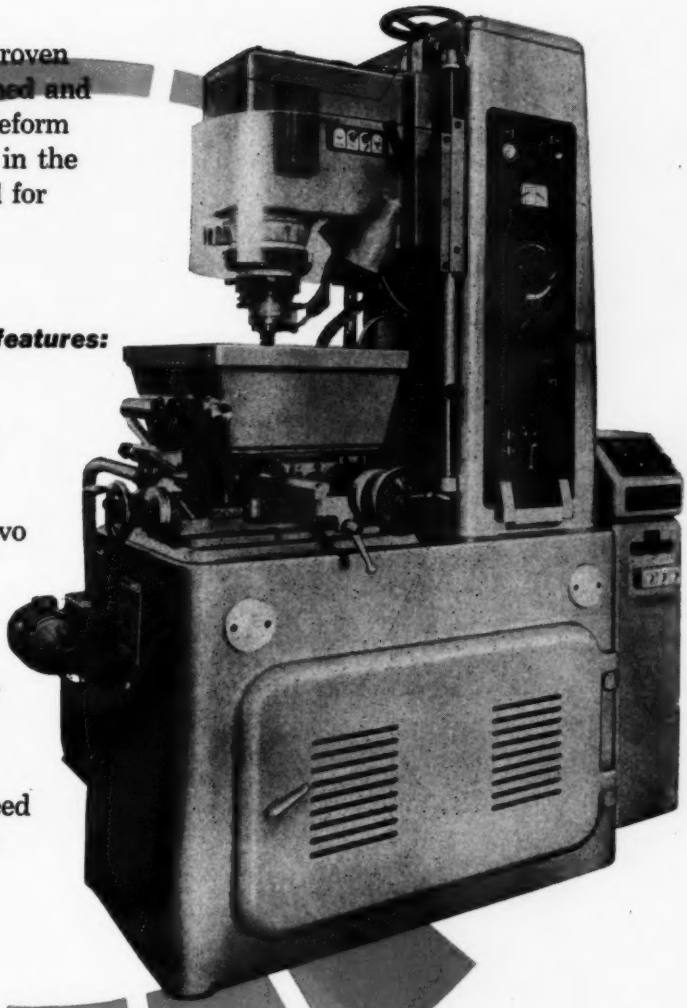
THE A. H. NILSON MACHINE CO. • 628 Bridgeport Avenue • Shelton, Connecticut

CIRCLE INFORM-A-GRAM KEY NO. 26

ELERODA D1

A precision electrical discharge machine

The ELERODA D1 was the first proven electrical discharge machine designed and engineered by CHARMILLES' Eleform Department, pioneers and leaders in the electrical discharge machining field for many years.



Here are some of its outstanding features:

- Magnetic electrode holder for working and locating within ±
- Specially designed hydraulic servo
- Table with jig borer accuracy
- The most stable electrical power unit on the market (no tubes)
- Highest guaranteed machine speed at 10 micro inches surface finish
- Heavily ribbed castings used throughout
- Simple controls and fully automatic

Complete service facilities available.

Write today for illustrated brochure to:

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CIRCLE INFORM-A-GRAM KEY NO. 27

UNIVERSAL TOGGLE-ACTION UNI-KLAMP

quick, positive, sturdy

Universal's Toggle-Action Uni-Klamps are engineered to give positive action with a minimum of force required for locking or unlocking. They're the fastest and most economical work-holding devices yet designed and they incorporate features recommended by independent tool designers, process engineers, tool makers and machinists. With clamp pressures available from 200 to 1200 lbs., there's a Universal Uni-Klamp in a size and type to suit your requirements. Write for catalog showing complete line.

TOGGLE LATCH TYPE CLAMPS | PUSH-PULL CLAMPS | PORTABLE CLAMPS | AIR OPERATED CLAMPS

UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 8, MICH. 218

CIRCLE INFORM-A-GRAM KEY NO. 28

CIRCLE INFORM-A-GRAM KEY NO. 29

You can do more with DELTA Metal Lathes

Checking closely on tolerances, time and dollars? These accurate, versatile, low-cost machines can pay their way on your jobs. To see a Delta Metal Lathe in action, write for the name of your nearest Delta Lathe Dealer and get a FREE CATALOG: Rockwell Manufacturing Company, Power Tool Division, 622J North Lexington Ave., Pittsburgh 8, Pennsylvania.

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

73% of first field reports indicate REX® 49 outperforms other high speed steels

Here are some typical comments...

NEW YORK--TURNING HEAT TREATED 4140--REX 49 SHOWED LONGER LIFE THAN T-1, T-4 AND T-15.

CLEVELAND--TURNING 4140 AT 300 BHN--REX 49 60 PER CENT LONGER LIFE THAN T-15.

WATERBURY--FACING STANDARD DIE BLOCK MATERIAL AT RC 35--REX 49 LASTED LONGER THAN T-15 AND CAST COBALT ALLOY.

EAST HARTFORD--TURNING TITANIUM C-120AV, 1200 RPM, .020" FEED, 1/32" DEPTH--REX 49 OUTPERFORMED T-5.

CLEVELAND--CUT-OFF TOOL CUTTING 3/4" SQ. T-431 STAINLESS--REX 49 CUT 50-60 PIECES BEFORE RESHARPENING. T-4, T-5, T-8 AND T-15 CUT 10-15 PIECES BEFORE RESHARPENING.

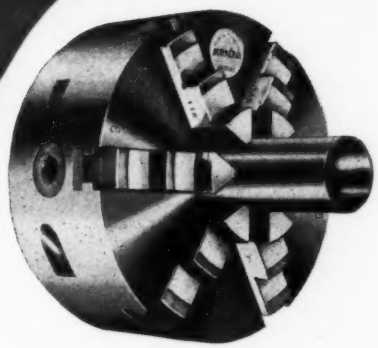
CHICAGO--REX 49 RUNNING 80 PER CENT LONGER BETWEEN SHARPENING FOR TURNING NICKEL SILVER ALLOY AND 50 PER CENT LONGER FOR TURNING MAGNETIC IRON THAN T-2.

NEW YORK--TURNING HIGH NICKEL ALLOY--REX 49 OUTPERFORMED T-15.

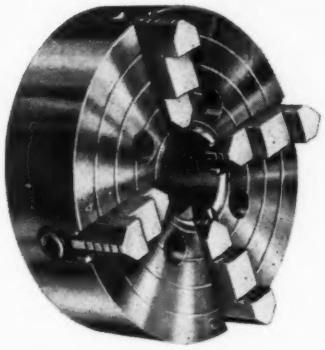
REX 49 is readily available from local Crucible steel centers. Call the Crucible technical service engineer nearest to you to find how you can benefit with REX 49. *Crucible Steel Company of America, Dept. HI25, Four Gateway Center, P. O. Box 88, Pittsburgh 30, Pennsylvania.*

CRUCIBLE STEEL COMPANY OF AMERICA

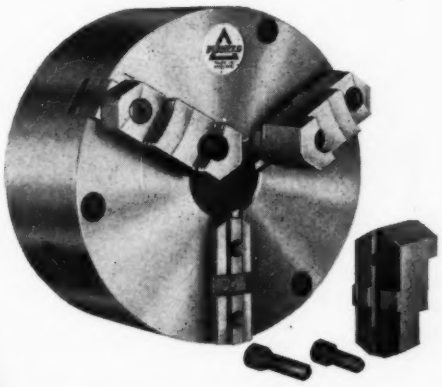
CIRCLE INFORM-A-GRAM KEY NO. 30



BURNERD GRIPTRU CHUCKS
3- and 6-Jaw, 4" to 12" Diameter
Chucks work to within .0002" at scroll chuck speed.



BURNERD INDEPENDENT CHUCKS
4-Jaw, 3¼" to 28" Diameter



BURNERD UNIVERSAL CHUCKS
3- and 4-Jaw, 4" to 24" Diameter
3-Jaw chucks are available with either two-piece jaws or two sets of solid jaws.

When you buy

BURNERD CHUCKS

you save as much as

30%

Built to uncompromisingly high standards of accuracy . . .

Guaranteed against defects in material and workmanship for a period of *two* years . . .

Backed by the coast-to-coast sales and service organization of Clausing . . .

Burnerd chucks are still so economically priced that they save you 20%—even 30%. For example:

A 6" Universal chuck costs only $78.50—a 12", only $180.00

A 6" 3-jaw GRIPTRU—which chucks duplicate parts to within .0002"—costs only $96.00

14" four-jaw Independent is $136.00!

Burnerd chucks are available for direct mounting to long taper or D-1 cam-lock spindles, or for backplate mounting.

SEND FOR LITERATURE TODAY

355

BURNERD CHUCKS

CLAUSING DIVISION
ATLAS PRESS COMPANY
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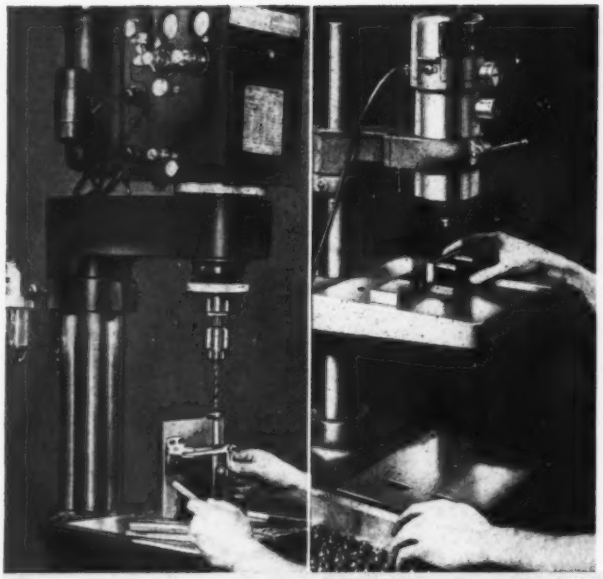
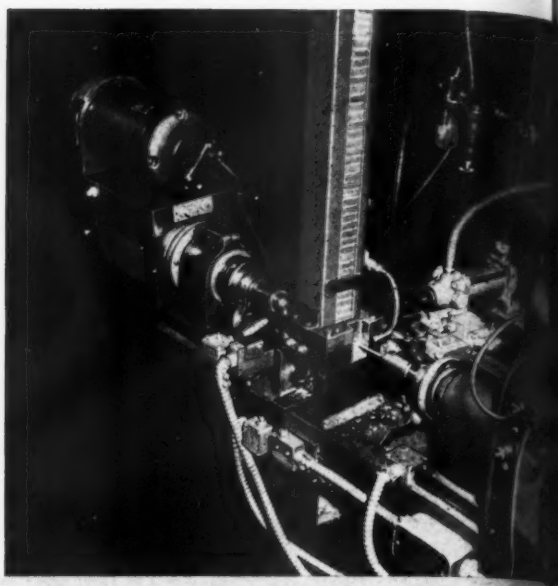


general purpose machining
Use any Dumore Drilling Tool for a continuous job...tapping, drilling, etc....in one set-up.



automated set-up
Combine one or several Dumore Drilling Tools with automatic workpiece feeding and holding devices for specific operations.

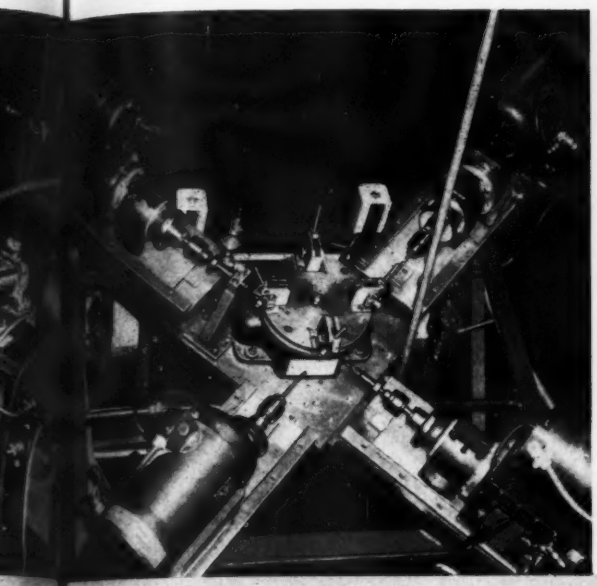
UNLIMITED MACHINING VERSATILITY

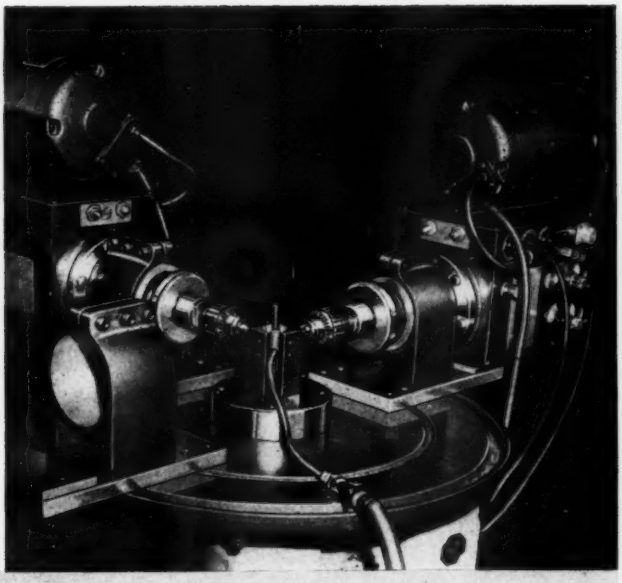
for holes from .001 to 3/8"

...1/2" TAPPING

You can tap, drill, ream, chamfer, spotface, center, deburr and do related work in general purpose, automated set-up, multiple machining and changing set-ups...at lower cost.

YOUR DUMORE DISTRIBUTOR HAS COMPLETE STOCKS FOR FAST DELIVERY



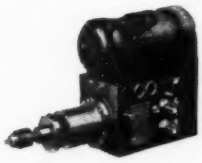


multiple machining
Combine several Dumore Drilling Tools in one set-up to perform several different operations, at the same time or in sequence.

changing set-ups
Move the same Dumore Drilling Tool to several different set-ups to do specific jobs.

DUMORE® PORTABLE, PRECISION DRILLING and TAPPING TOOLS

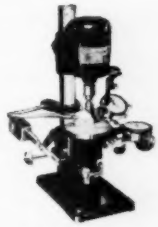
"hi-speed" units
800 to 15,000 rpm speeds for holes from .020" to 1/4", 2 models. From **$865***



"drill-n-tap" units
Drills or taps automatically at the flip of a switch. Drilling No. 60 to 3/8", tapping 0-80 to 1/2-13. (in mild steel). From **$907.50***

drill units
Automatic drilling units. Built-in power and controls. 2 models. Drills No. 60 to 3/8" (in mild steel). From **$595***

drill heads
No. 80 to 5/32" drill capacity—built-in power for automatic operation. 2 models. From **$237.50***



micro-drill
Drills small holes from .001" without special operators. A miniature jig borer. **$625***

sensitive drill press
No. 80 to 1/8" drill capacity. Foot switch operation. **$102.50***

*FOB Racine

drill speeder
Converts standard drill press or lathe to high speed driller. Fits into chuck, supplies its own power. No. 80 to 1/8" capacity. **$47.50***

and Dumore engineered production tools and accessories including complete automatic drill presses and fixtures.

YOU CAN DO MORE WITH

DUMORE® PORTABLE PRECISION METALWORKING TOOLS

THE DUMORE COMPANY

1304 Seventeenth Street, Racine, Wisconsin

HI-SPEED DRILL UNITS • DRILL-N-TAP UNITS • DRILL UNITS • DRILL HEADS • MICRO-DRILLS • DRILL GRINDERS • TOOL POST GRINDERS • HAND GRINDERS • FLEX-SHAFT TOOLS • QUILLS AND ACCESSORIES • VERSA-MIL UNITS

When you have a need for erector-type components for special machines... machining heads, feed tables, machine beds... contact our subsidiary Master Manufacturing Company, Hutchinson, Kansas.

SEE HIM FOR A DEMONSTRATION...OR WRITE FOR BULLETIN D-60-C

CIRCLE INFORM-A-GRAM KEY NO. 33

Built by EX-CELL-O

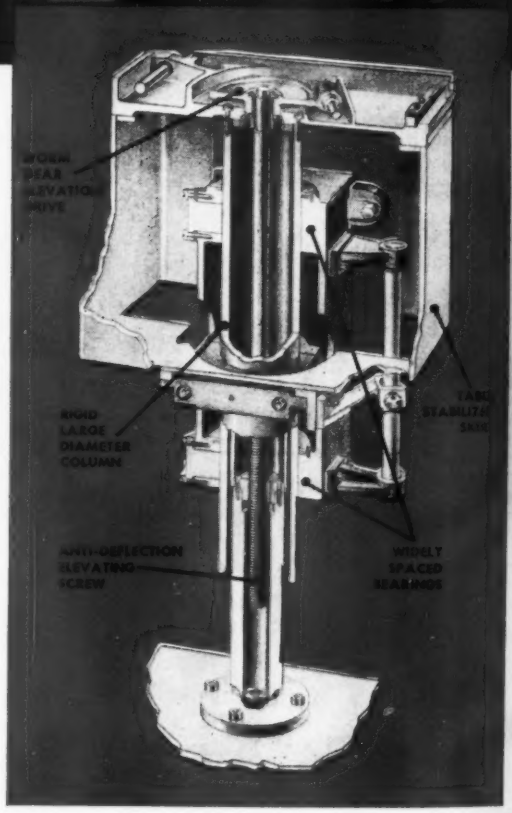
To Insure Accuracy

Rugged, precision construction of Ex-Cell-O Contour Projectors results in stable support for the optical systems providing accuracy in the order of .0001". This rigidity is a major consideration in achieving for Ex-Cell-O Projectors an outstanding record of trouble free operation and almost total elimination of down time.

Typical of the sturdy, precision workmanship to be found throughout Ex-Cell-O Contour Projectors is the worktable of the Model 14-5 and Model 30. Engineers will recognize the superior design features shown in the inset at right. To cite just a few, the large 5" O.D. columns, supported in widely spaced bearings; the heavy channel skirt to stabilize the table assembly and the flexible elevating screw which can't impart deflections to the column.

Because of these construction features Ex-Cell-O Contour Projectors support heavy loads firmly, yet move easily and smoothly.

Whether your problem involves receiving, production or final inspection there's an Ex-Cell-O Contour Projector to do the job accurately, quickly and at low cost. The "why" and "how" is condensed in our new booklet—"43 Reasons Why Ex-Cell-O Contour Projectors are the First Choice of Industry." Yours for the asking!



Manufactured by EX-CELL-O Corporation at Detroit, Mich.

SOLD AND SERVICED BY

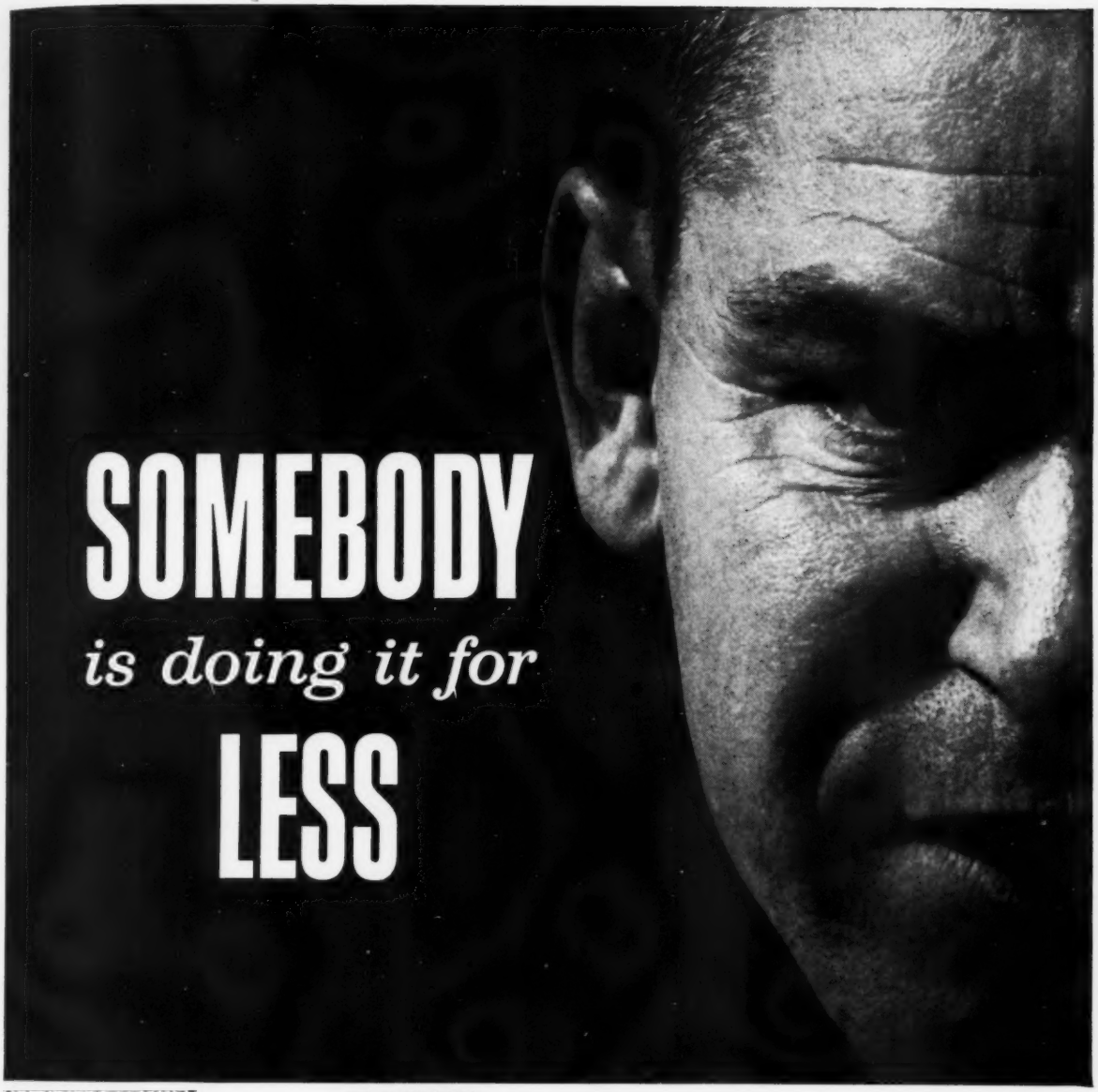
CP61-2

OPTICAL GAGING PRODUCTS, INC.

26 FORBES STREET ROCHESTER 11, N. Y.

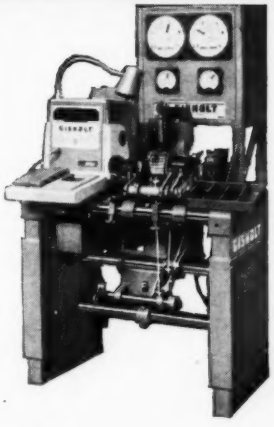
Subsidiary of EX-CELL-O Corporation

CIRCLE INFORM-A-GRAM KEY NO. 34



Gisholt MASTERLINE® 1S Balancer—Shown with separate unbalance location (angle) and amount meters for each correction plane. Readings hold until corrections are made. Offers complete plane separation—needs no special foundation—correction planes can be inside or outside work supports.

New HS line handles miniature, high-speed parts—impellers, armatures, gyros, self-driven assemblies.



Contact your Gisholt Representative, or write for Catalog 1109D.

How long since you analyzed your balancing methods in light of recent developments?

One year? Two years? Take a fresh look. If you still rely on operator skill or judgment, accuracy suffers, time is lost, reject rates or field failures are high.

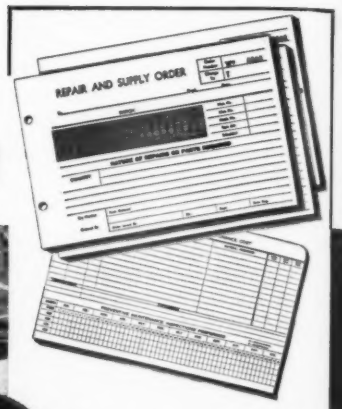
With Gisholt balancers, guesswork is eliminated. You can locate, measure, correct and inspect in *one handling.*

Only Gisholt offers all the advantages you need to do it for less.

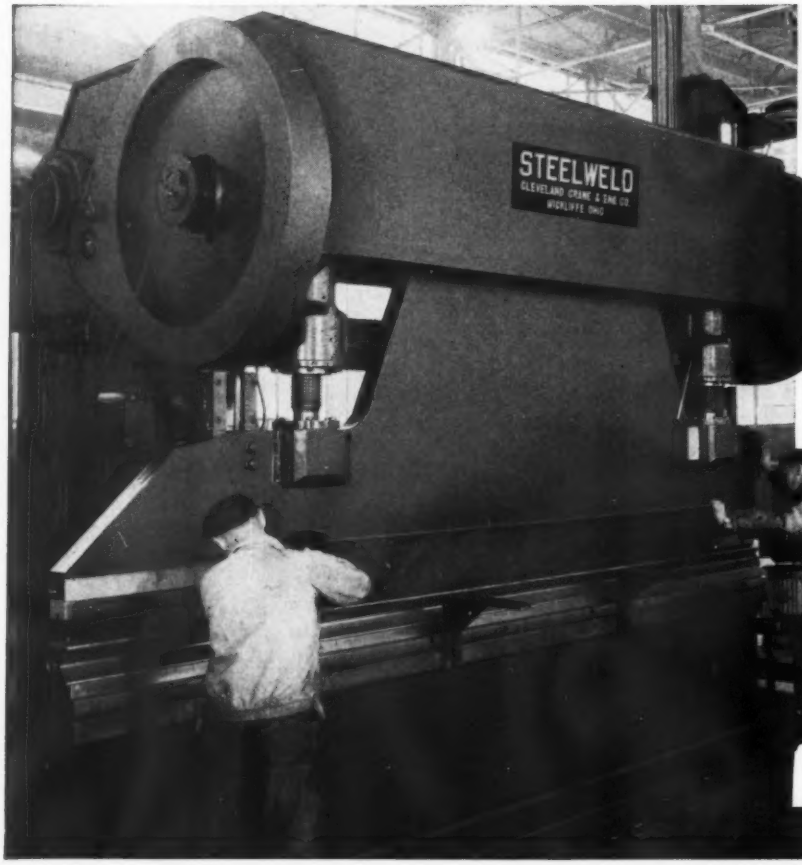
GISHOLT
MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

CIRCLE INFORM-A-GRAM KEY NO. 35

Accurate Records Prove
LOW COST OPERATION



These forms enable the Chicago Plant to develop records which provide concrete facts on repairs and maintenance for all machines.



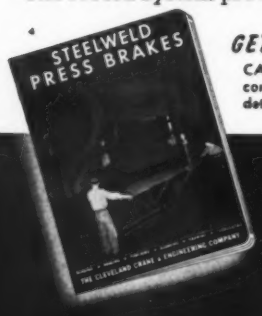
A Steelweld Model J4½-10 press working on various size steel plates up to 16'-0" x ¼". The ease with which the hand-cranked back gauge is adjusted is a favorable feature. The press is easily jogged in minute amounts. Shown is a 14'-0" x ¼" plate being formed for a hopper.

Link-Belt manufactures a wide variety of conveying and processing equipment such as apron, screw, oscillating and overhead chain trolley conveyors, railroad car dumpers, bucket elevators and other handling equipment.

SOME YEARS AGO the Pershing Road Plant of Link-Belt Company, Chicago, established a record system for keeping track of repairs and maintenance costs of all machine tools. This system provides a detailed history of maintenance required and lists every item of expense for every machine.

The record system proves that the maintenance cost for Steelweld machines, both bending presses and shears, is comparatively low.

Because of this, and the fact that Steelweld machines have many desirable operational features, a number of which are unavailable elsewhere, Link-Belt regards them highly. In fact, so much that 20 Steelweld Presses and Shears are now serving Link-Belt plants in nine cities.



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CIRCLE INFORM-A-GRAM KEY NO. 36

TOOLING & PRODUCTION
The Magazine of Metal Working Methods

Needed!! Company Interest . . . not department interests

THE OTHER DAY at a press conference, as we milled around a machine, engineers were referred to in seven letter terms. Persons other than the press made the remark. In this instance purchasing wanted to buy the machine, but feared it couldn't perform to the tolerances those "b-----d engineers" apply.

"Many a serious word is said in jest." This I know, but it brought back sad familiar memories of a condition that existed where I worked. Production people, and inspection, had an almost open hatred for engineers.

Yet engineering had a right to be irked at continual inferences of incompetence. In most instances engineering is closest to an understanding of the total project. And engineers have a right to be adamant on many things . . . tolerances for instance.

Part of the problem, which still exists, stems from the fact that for a number of years engineers have been wooed and coddled. But they have been realistically in demand. Many have been forced into service with improper training and production people have had to live with errors. And there's no letup: just recently a large aircraft company hired another 500 engineers. Yes, 500 not fifty.

The situation will never be completely corrected, but better understanding and appreciation for the work of others would work wonders. As management, why not consider a modest training program to help each group within your facility understand the others? Try to foster understanding between those that work closely together.

Perhaps you can't put your finger on this business of departments sniping at each other, but it's there. Every company large enough to be departmentalized has some efficiency loss from this failing. What is the total effect? How can the situation be corrected?

You know your situation best. If you are looking to upgrading your company operation in every way train your people to understand each other. And Mr. Employee, don't leave it all up to management. What would be the increase in gross product if we all "face up" to reality?

William S. Hoffman
Editor

UNIVERSAL JIG AND FIXTURE COMPONENTS AND CLAMP ASSEMBLIES

Shown here are a few of more than a thousand different items in regular steel and stainless steel —the largest and most complete selection in the United States—now available from Universal Engineering Co. Write today for your copy of the complete, new catalog.

213

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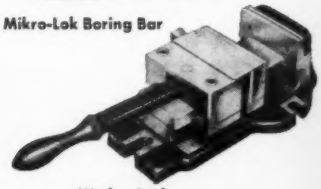

Wedge-Lock Production Vise

UNIVERSAL ENGINEERING COMPANY, FRANKENMUTH 8, MICHIGAN

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TOOLING & PRODUCTION

The Magazine of Metal Working Methods

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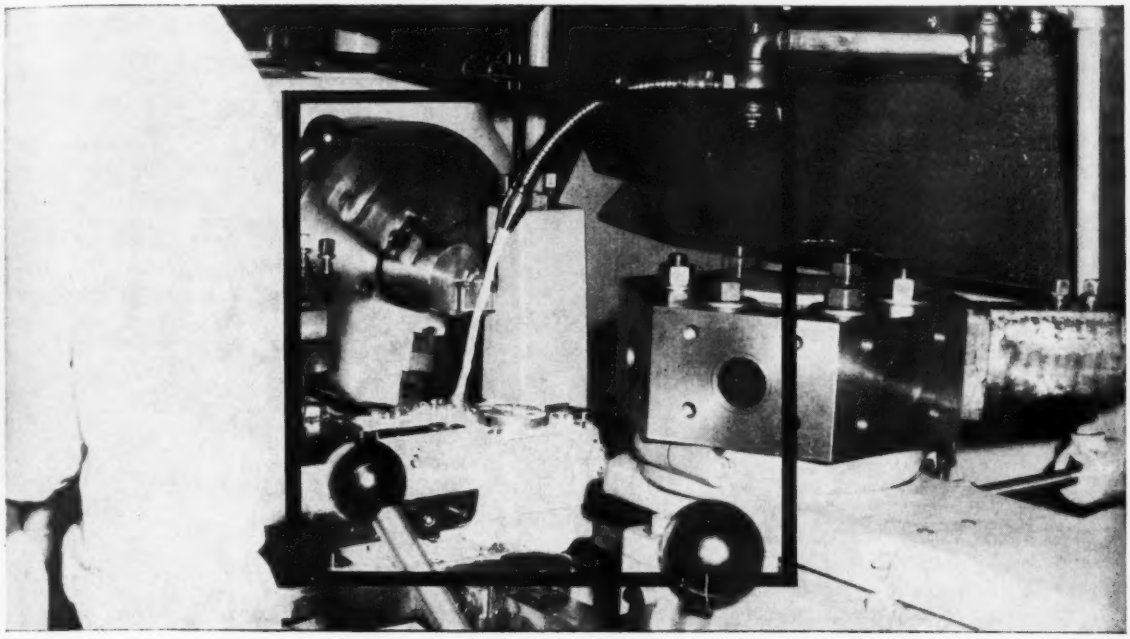
SEPTEMBER 1961



Breakthrough In Cutoff

by Horace Frommelt

Dr. Frommelt is Director of the Manufacturing Research Center at Ferro Powdered Metals, Inc., Salem, Ind.

UNTIL THE DEVELOPMENT OF THE THROW-AWAY INSERT, cutting-off (slugging, parting, etc.) was restricted to conventional tool materials such as HSS, Stellite and Tantung, with occasionally a carbide tip brazed on a steel shank.

Advantages of the throw-away have caused a re-evaluation of this operation. Economics dictate that it is no longer feasible to use anything but carbide for the job.

In Fig. 1 carbide is shown, although ceramics can be used. All parts, including the shank, are made of powdered metal, comparable in strength to conventional shank material.

Economies are possible because of molding techniques that create serrations on the shank seat, the underside of the insert, the back of the shank shelf and the back of the insert. These are "free" because they do not call for extra operations. A tongue and groove arrangement for the clamp is also possible. Essential to effective use, these features might not be easy to come by if machined.

In Fig. 2 chips made at a 0.030 feed per revolution are shown. Due to pressures involved in their creation, they have become thicker (perhaps 0.050) than would be expected from the 0.030 calculated feed. Data taken when they were made is presented in Chart 1.

Test results in Chart 1 were made at progressively decreasing speeds to determine the strength and rigidity of the tool at excessive cutting pressure. Associated Engineers, Inc., who made the test, have found that normal cutting speed for 1045 steel is 500 sfm at a feed rate of 0.015. However, the 0.030 feed can be selected for materials comparable to 1045, providing the power is available.

Fig. 1 With molding techniques, positioning tongue and groove arrangements make it possible to replace throw-away tips without taking out shank, so cutoff is repeated easily and exactly.

Values in Chart 1 require 25-hp or more for the cu in/min displacements listed. For steels, the general requirement is about 1-hp/cu in/min removed for turning and facing operations. But in parting, the hp requirements increase by as much as 25%. Powdered metal tooling can be used to reduce hp requirements.

The K factor (hp requirement/cu in of metal removed) decreases when powdered metal tools are used, due to damping, or the lessening of vibration, which accounts for a loss of power. Vibration also results in early edge deterioration, which in turn calls for more power.

Problems on Multiple Setups

Cutoff has been the bugaboo of multiple machining setups, for production cannot go faster than the rate for the slowest tool. This is true of all machines whose spindle speeds cannot be individually set. For example, the No. 4 Morey turret lathe in first photograph has been arranged so that all operations can be performed at carbide speeds. Measured in dollars and cents, efficiencies become apparent in manhour time to cutoff.

With an HSS cutoff tool, the sfm rate might be 90, while that of a carbide throw-away would be 500. Here is a 5½ times rate increase, but the feed is run up from 0.006 to 0.015 — a two times plus increase. Parting time with HSS is clocked at 3.5 min, but with carbide only 0.26 min. The study involved 100 slugs, at a $7.50/hr manhour cost, cost of $44.00 for cutting off with HSS, and $3.20 for the same operation with carbide. The cost difference is still more striking when cutting off 4150 steel where the rate for HSS must be dropped to 50 sfm and to 350 sfm for carbide. Cost here was $87.50 with HSS, and only $7.30 with carbide.

The difference is so great in either example that the disadvantage of a wider kerf, which results with carbide, can easily be justified. The wider kerf is often erroneously cited as a great disadvantage, and frequently dominates the parting operation.

Why the wider kerf with carbide? When this sintered material is brazed to a steel shank, it is necessary that it be more than ⅛" wide for rigidity — ¼" is usually specified. This is not a consideration with the throw-away.

Chart 1 Slugging a 1045 steel bar 3" dia. The slugs were cut ¾"long.

Test No.	Rpm	Sfm	Ipr	Parting Time (seconds)	Cu in/min
1	800	600	0.030	3.7	28.0
2	700	520	0.030	4.3	24.0
3	600	420	0.030	5.0	21.0
4	500	375	0.030	6.0	17.5
5	400	300	0.030	7.5	14.0
6	300	225	0.030	9.0	11.6
7	200	150	0.030	15.0	7.0

Kerf and Costs

How does kerf affect the final cost? With a ¼" kerf, twice as much cutoff material will be wasted in performing the cutoff. In the tests mentioned above, every cost item was carefully considered and controlled. For example, the cost of bar stock was carefully averaged out. For an HSS cutoff tool (the same would be true for Stellite and Tantung), with its ⅛" kerf, the material cost to obtain 100 slugs was $2.25. For carbide, with its ¼" kerf, the cost was $6.50. Even with this disadvantage, the picture is little changed when you figure all costs such as manhours, grinding, first tool cost and material cost.

The comparison is: On 1045 with HSS the total cost/100 slugs is $48.62; with carbide it is $12.70. In parting 4150 with HSS, the total cost/100 slugs is $95.37, with carbide, $23.30.

The cost of wasted material with

Fig. 2 Slug and some chips from the bar test. Results are tabulated in Chart 1.

Stellite and Tantung on 304 stainless steel is $18.75/100 slugs, while with carbide the kerf cost is $37.50, since the parting slot is twice as wide. Yet the saving with the throw-away carbide cutoff tool is appreciable — $5.25/100 slugs.

The greatest saving however, cannot be included in this study, for good reason. Machine downtime, today a determining factor in practically every operation, is greatly reduced with the throw-away cutoff tool. When parting on a lathe, downtime normally can be ignored. But on all multiple spindle machines as well as in all multiple tool setups in turret lathes, downtime dominates the final cost of parts produced.

Several operational conditions must be considered. First, there is the use of HSS cutoff tools in a machine where the spindle speeds cannot be separately set. In this case, if all other operations such as turning, boring, etc., are run with carbide, little or no benefit will result, because all spindle speeds would have to be brought down to that of the HSS. If this is done, the overall loss of production would be alarming.

Second, if spindle speeds can be handled individually, the cutoff operation might be done with HSS, and the others done with carbide. However, machine downtime, due to more frequent changing of HSS cutoff tools, would be increased.

Third, a brazed carbide cutoff tool might be used in conjunction with other carbide tools. This would mean the loss of the setting of the cutoff tool each time the tool is changed, resulting in an inordinate amount of time for re-setting.

Compare the third approach to using throw-away carbide cutoff tooling, shown in Fig. 1. Once the shank is set for a job, it is never changed throughout a production run. The insert is replaced each time to its repeat position, due to dovetail features. Because of varying conditions, it is impossible to truly evaluate this approach, yet it would dominate every cost study.

With throw-away tools, downtime can be reduced almost to the vanishing point — a real breakthrough in machining. ■

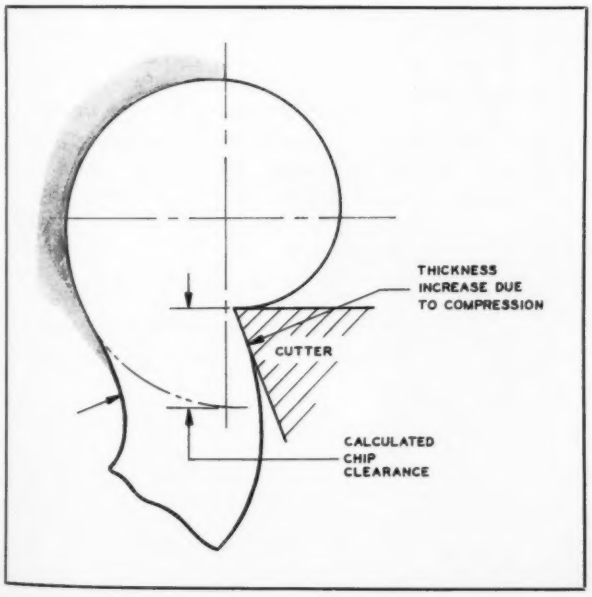


Fig. 3 To show how chip thickens, due to compression.

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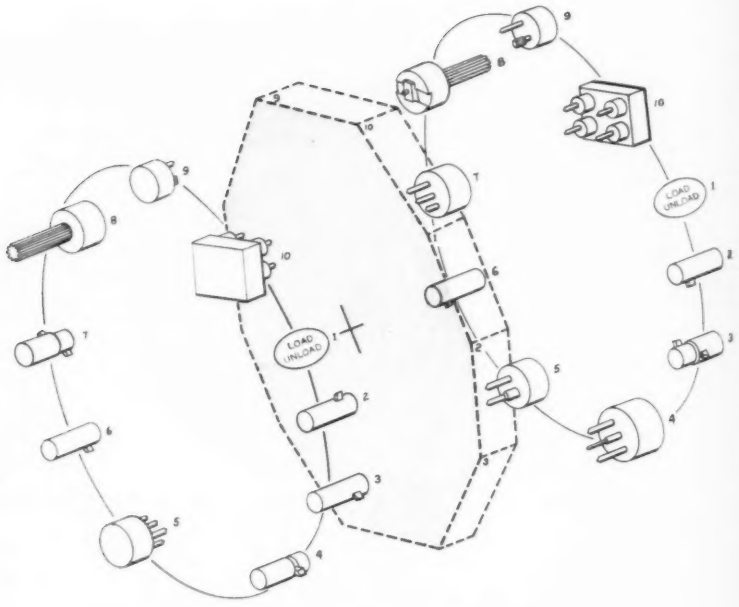


More Production, Closer Tolerancing . . . from a trunnion machine

by A. J. McLaren
Vice President
The Cross Company
Detroit, Michigan

CERTAIN PRODUCT DESIGNS require more than individual machine tools for their production, and manufacturers must look to automatic special purpose machine tools, Fig. 1. Or, a product redesign may dictate process reconsiderations and consequently different machining techniques.

A good example of a part requiring new processing methods is the remote-accessory cylinder for tractors, Fig. 2.

A major redesign called for closer tolerances to give better service for a longer period of time. Production engineers pointed out that the new tolerance requirements called for different processing. More operations would be required, and squareness tolerances of the faces to the cylinder bore could not be met if the part were chucked more than once. But desiring a higher quality product, management authorized the new design **and** the production facilities necessary to achieve it.

The production facilities were to machine the two different sized cylinders of nodular iron or gray iron. Because of the inter-related operations a trunnion machine was chosen to best fulfill processing requirements.

Processing includes rough, semi-finish, and finish-boring. Cover-

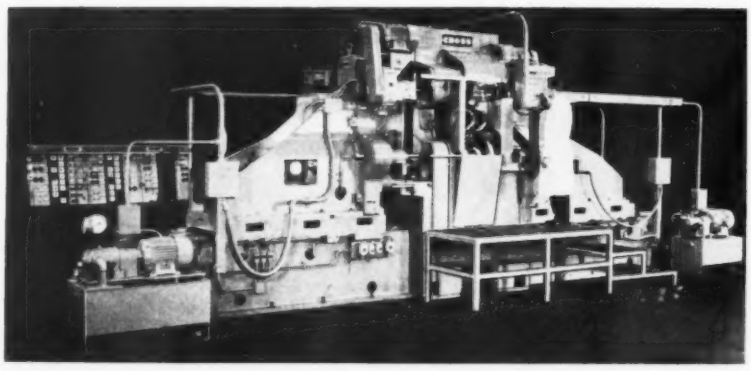


Fig. 1 A large trunnion machine that accurately bores and faces cylinders for tractors. The 10-station machine also includes drilling and tapping operations.

plate and port holes are drilled, counterbored, reamed, chamfered and tapped. In addition, a groove is recessed at the lower end of the main cylinder bore. Cylinder faces are milled before castings are loaded into the machine.

Cutting tools are carried on two main heads and four auxiliaries. Both main heads start feeding inward at the same time, but the left-hand has a stroke 3 to 6½ times as long as the right-hand head, depending on which cylinder is being machined. The tough, nodular iron requires a 16 sec longer machining time than the gray-iron cylinder. The left-hand head determines the production rate of the machine.

To prevent interference between tools on the two heads, they are electrically interlocked to stop the left-hand head at a predetermined point in its cycle if the other head has not already completed its cycle by this time.

The Cycle

After a cylinder is manually loaded at Station 1 (from the front) and clamped in the fixture, it is indexed to Station 2, the first work station. Here a boring bar on the left-hand head roughs the main bore with a carbide cutter, and the cutter of the right-hand head roughs a smaller hole on the same centerline.

These concentric bores are semi-finished at Station 3 at a higher cutting speed and lower feed rate.

At Station 4 a groove is recessed near the bottom of the main bore by a tool carried on the left-hand head. Since the recessing tools are liable to bottom due to variations

Fig. 2 Two views of one of the cylinders showing machined faces and openings. One cylinder is made of nodular iron and the other of gray iron, yet both are processed on the same machine.

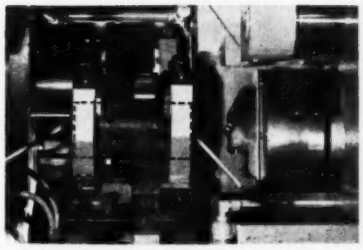


Fig. 3 Both ends of the cylinders are faced with generating tools, one of which is visible at the right. This tool block also carries a chamfering tool to bevel the edge of the main bore.

in the stock thickness at the bottom of the cast hole, two feed rates are used for the left-hand head. It feeds 9.4″ at a rate of 4.5 ipm and then feeds 0.4″ at a rate of 2.25 ipm.

The recessing tool is mounted in a carrier with an adjustable nut. As the head feeds inward at the higher rate, the nut contacts a bushing, and the feed rate drops. As the head continues in, the recessing blade feeds out to cut the groove.

Cover-plate holes are drilled at Station 5.

After the casting is flooded with coolant to remove chips, the main bore is finish bored at Station 6. A cutting speed of 145 sfpm is used at a feed rate of 0.024 per cutter blade, and the bore is finished to a diameter of 2.995″ +0.000 −0.002 for piston fit. The smaller bore is finished to a diameter of 1.628″ ±0.001, concentric with the main bore within 0.004 TIR.

At Station 7, counter-boring is handled.

At Station 8, both end faces are generated. See Fig. 3. The left-hand must be flat within 0.003 and the right-hand face must be square with the main bore within 0.001 per in. Concentricity and squareness requirements were some of the major reasons for going to automatic processing. In this way castings are only located and clamped once to achieve relationships.

At Station 9, cover plate holes are drilled in each face followed by tapping at the final work station, Number 10.

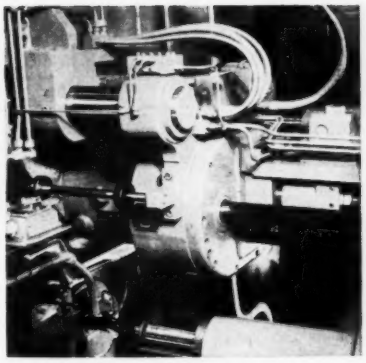


Fig. 4 Generating heads are carried on the trunnion supports powered by spline shafts from the main heads. Through the spline drive, power is available to the generating tool throughout the feed stroke of the head.

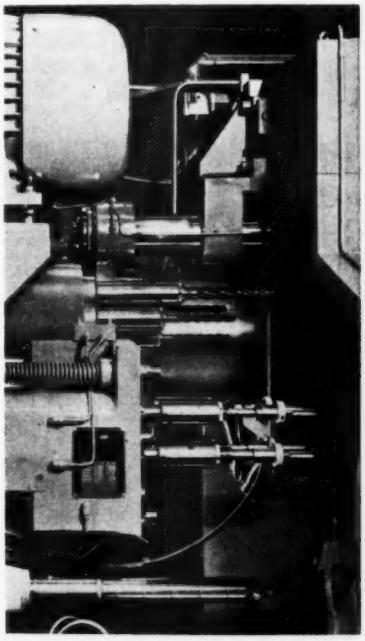


Fig. 5 Tapping heads are mounted on the main heads. They are fed in with the main head, but when their separate lead-bushing plate is contacted, the taps feed out and retract independently.

Design Flexibility

The flexibility of a trunnion machine is well illustrated here by the inclusion of the four auxiliary heads. Two of the generating facing heads are suspended from the trunnion supports, being powered through spline shafts from the main tool heads. See Figure 4. Due to this arrangement, the gen-

erating tool is in its cutting plane at the start of the main-head feed stroke, and power is available for feeding throughout the main-head stroke. This comparatively slow operation can thus be accomplished without addition to the machining cycle time.

The tapping heads are mounted on one of the main heads, Fig. 5, and the tap lead-bushings are mounted in a separate plate. They contact a stop and retract while the main head finishes its stroke.

Operating Flexibility

Since cylinders of two different materials and sizes are processed on this trunnion machine, its operating flexibility is important. Nodular iron and gray iron have different machining characteristics, and for optimum processing of both, speeds and feeds had to be adjustable. This was easily accomplished through the inclusion of change gears and hydraulic flow-control of the main heads.

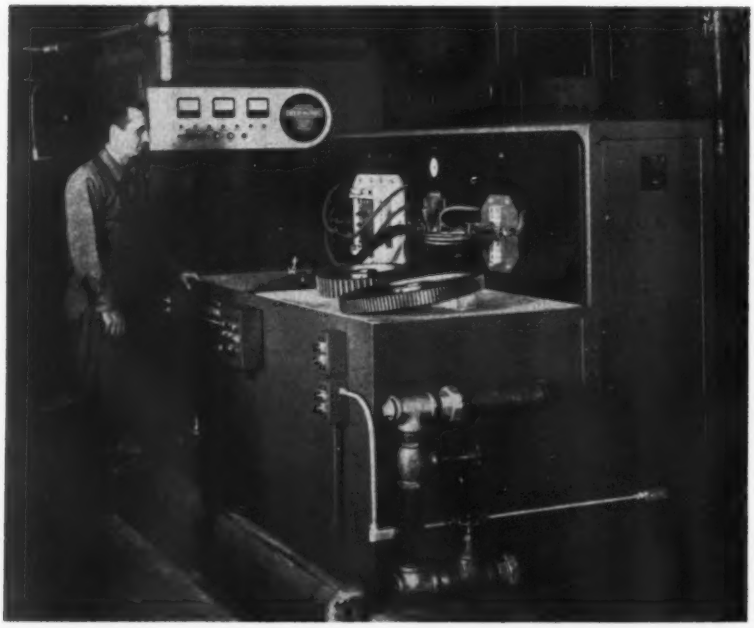
Also, because the cylinders are of different lengths, feed strokes had to be adjustable, and tools and fixture details are interchangeable. All of the adjustments and substitutions required to shift from production of one part to the other can be accomplished by one man in 30 min.

Because of this flexibility, the machine can effectively process cylinders of future design. ■

50 KW Unit Speeds Hardening

The first 50 kw-powered heat treating equipment ever used is now performing at Bennett Heat Treating Co., Inc., Newark, N.J. High precision parts or standard-sized parts are hardened, brazed and annealed on a single 50-kw machine with interchangeable high and low frequency ranges. The unit, designed and built by Induction Heating Corp., Brooklyn, N.Y., can operate between 200 and 450 kilocycles or from 5 to 10 megacycles. It allows fast heating with shallow penetration, and decreases deformation and surface scale.

Among the parts processed by the new equipment at Bennett were high-precision small and medium-sized gears. The hardness pattern produced by the high frequency current followed the contour of the gear teeth from face to root, and appeared similar to that produced by conventional case-hardening methods. Unlike the conventional methods, however, only the surface was heated by this frequency, therefore practically no change in the gear dimensions occurred.



Heating cycles were shorter than anticipated, making it necessary to use a heat timer with 0.01 sec sensitivity. The hardening temperature for extremely fine-tooth gears was reached in only 1/5 sec. No oil or water quench was used because only the surface had been heated, and the remaining unheated metal caused the parts to chill so rapidly they became self-quenching.

Uniformity in heating assured uniform hardness; and the split-second timing assured uniformity of one part to another. The gears were handled in complete safety on a production run basis at 7½ million cycles.

Most of the "regular" induction hardening jobs at the company are processed with a frequency of about 300 kilocycles. Again, output has increased substantially because of the fast heating with shallow penetration. When deeper heating was desirable, output of the equipment was reduced, and the heating time was extended by a few seconds.

The work stations of the machine are equipped for automatic spray or drop quenching of the work by water, oil emulsion or oil. Temperature of the oil emulsion and oil is controlled by a combination heating-and-cooling heat exchanger. Uniform penetration of heat from all sides of the parts is assured by a built-in revolving fixture.

Electronic Instruments ...Watchdogs Of QC

by W. R. Thurston
General Radio Company
West Concord, Massachusetts

QUALITY CAN often be improved when additional instrumentation is used with your production procedures. Here are two "instruments" that may prove of value to you.

Stroboscopes are not new; they have been used to measure speed and to observe high-speed motion, in apparent slow motion, for many years. What *is* new is their design for applications that require viewing of minute detail with sharp clarity. The Strobotac combines a very high-intensity light and an ultra-short flash duration for viewing fine detail. Since it involves a very small light source, a narrow beam can be achieved with a small reflector. This is important to beam into machinery, and to focus on small subjects.

Defects in machinery, such as worn or chipped gear teeth, rough bearings due to a ball being out of round, and undesired mechanical resonances due to unmatched relative values of masses and spring constant, can be checked with the Strobotac. Strobotac accuracy is within 1%, and can be verified at any time by the 60 cycle line frequency.

Even such minute detail as scratches and specks on parts, and the smear pattern of the lubricant used, appear essentially the same as they do when standing still.

Fig. 1 shows a Strobotac measuring grinding wheel speed on an automatic cam shaft grinder. To obtain the best possible finish without exceeding the rated operating speed of the grinding wheel, it is important to measure speed

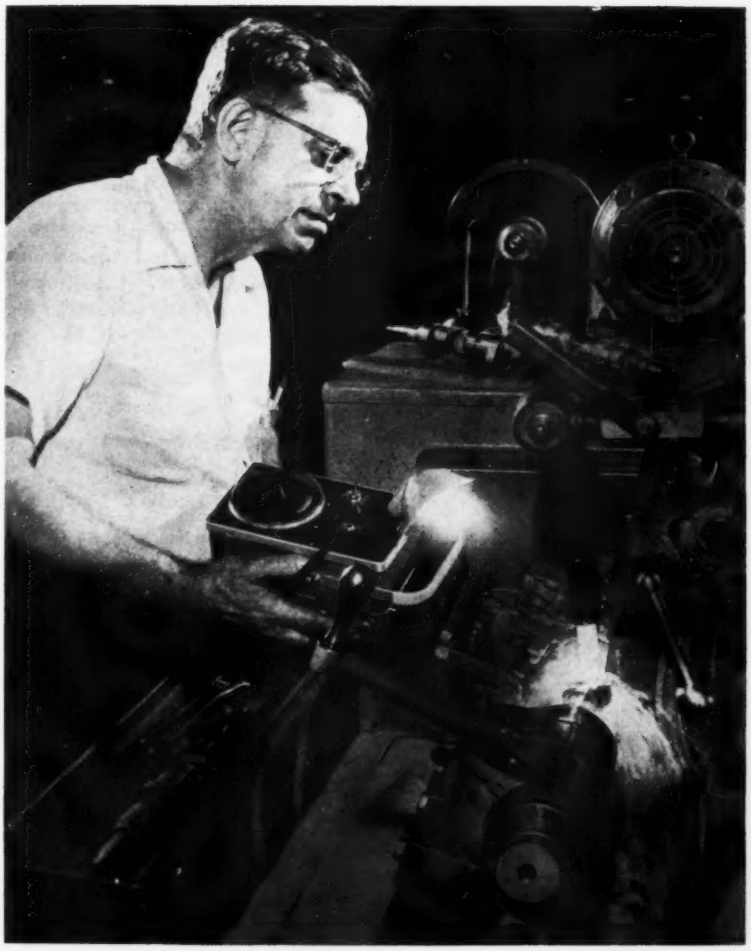


Figure 1

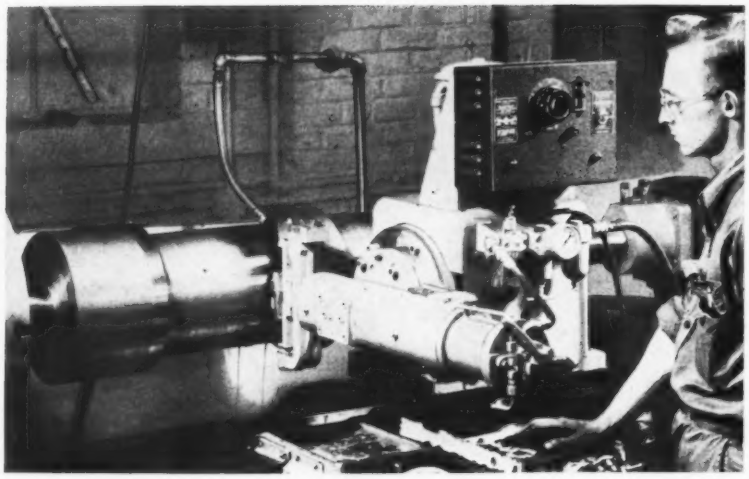


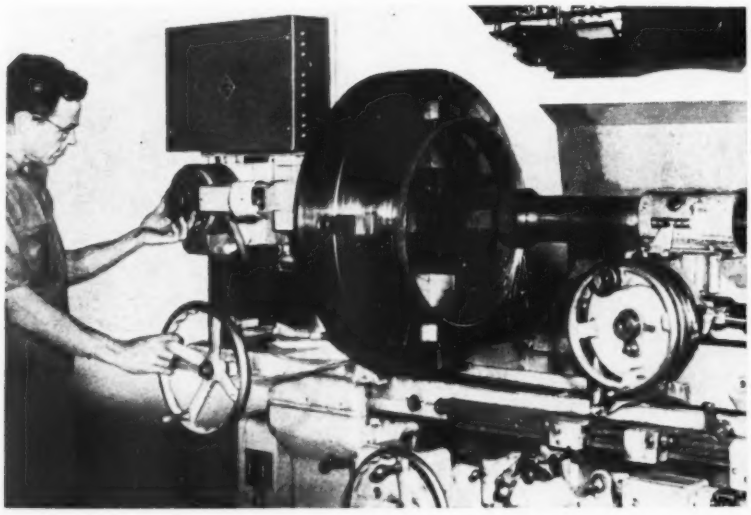
Figure 2

accurately. By this means it is feasible to operate the grinding wheel at a predetermined speed of 64 fpm, compared to its rated speed of 65 fpm.

Motor-speed controls employing a variable transformer and full wave rectifiers are also extremely useful electronic tools. A standard *dc* motor can be operated from an *ac* line for smooth operation at very low speeds, but some motor speed controls supply a jagged wave form, which shows up as a 60 or 120 cycle torque pulsation. This pulsation can produce ripples in the product surface finish on a grinding machine. The optimum smoothness possible at low speeds is demonstrated on a Gisholt super finishing machine and Heald grinder, Figures 2 and 3, respectively. The machines employ a Variac.

The Variac variable transformer was used for many years in low power applications in electrical laboratories. However, in the last 10 to 15 yrs it has been given industrial "workhorse" jobs. A new invention, which stabilizes the electrical properties of the contact in such variable transformers, has made the variable transformer as reliable as a fixed one under severe operating conditions. ■

Figure 3



Management and Automation—Phase II

MANAGEMENT PROBLEMS IN THE ACQUISITION OF SPECIAL AUTOMATIC EQUIPMENT, by Powell Niland. Published by the Harvard Business School, Harvard University, Boston, Mass., 1961, 336 pages, $5.00.

This volume is the fruit of the analysis of the management implications of advanced technological developments in production — an analysis conducted by the Business School's Division of Research. It's the second effort on a similar theme from that source. The first was James R. Bright's authoritative "Automation and Management." This one should be equally well received.

The author, now professor of management at Washington University, thoroughly considers the "locus of major problems" encountered by 18 firms in the acquisition of advanced equipment. Some of the common ones treated are debugging, working with equipment vendors, coordinating product design and the automation equipment, and the analysis of product proposals. But emphasis is on the administrative ramifications of the acquisition process, rather than the technical.

Broaching Book Reviewed

BROACHING — TOOLING AND PRACTICE, by Horace E. Linsley. Published by The Industrial Press, 93 Worth St., New York 13, N.Y., 1961, 216 pages, $6.50.

Broaching, a process often avoided because of ignorance of its advantages, is here covered in seven concise, expository chapters. Chapter titles are: the broaching process, internal broaching, external broaching, broach design, broaching machines, fixtures, and setting up, trouble shooting.

The author's purpose here is to describe the cost-reducing and production boosting capabilities of the process as more than "the only reasonable way to produce square holes and keyways."

Machine Replacement For The Shop Manager

Chapter VIII- A Practical Method For Finding Rate Of Return On Machine Tool Investments

by Baxter T. Fullerton

Mr. Fullerton is Director of Marketing Services, The Warner & Swasey Company, Cleveland, Ohio.

A PRACTICAL METHOD for finding the rate of return on machine tool investments must, above all else, be easy to use. The longhand method worked out in detail in the last chapter is technically sound, but is not practical as a day-to-day shop operating tool.

It suffers from two weaknesses. It takes too much time to work out the detailed calculation, and it solves the problem more accurately than is necessary. If the cost savings figure put into the calculation is to be even close to actualities, it must contain several estimates of values. We should not kid ourselves that an accurate calculation of the return makes up for inaccuracies in these estimates.

We need a quick method to obtain a reasonably accurate rate of return.

The Rate Of Return Table

The table, Fig. 1, introduces just such a method. In view of the complexities of machine replacement and of the longhand calculations, this table is almost startlingly simple! Here is how it works.

To find the rate of return on the average machine tool investment it is necessary to know only the first year cost savings. When we know these savings, we divide them by the amount of the investment to find the **Gross First Year Percent Return.** From **Gross First Year Percent Return** we look across the table to find the **True**

Figure 1

TABLE FOR FINDING RATE OF RETURN ON MACHINE TOOL INVESTMENTS

Gross 1st Year % Return	*True Rate of Return after Taxes**	Equivalent Rate of Return before Taxes#
50%	30%	60%
45	27	54
40	24	48
35	21	42
30	18	36
25	15	30
22	13	26
20	11.5	23
18	10	20
16	8.5	17
14	7	14
12	5.5	11
10	4	8
9	3	6
8	2.25	4.5
7	1.5	3
6	0	0
5	0	0

HOW TO USE THIS TABLE

1. Divide first year earnings by amount of investment to find Gross First Year % Return of proposed new machine(s).

2. Read across to find *True Rate of Return after Taxes* and *Equivalent Rate of Return before Taxes.*

EXAMPLE:

$20,000 machine with $4,000 earnings
$ 4,000 ÷ 20,000 = 20%
True rate of return after taxes . . . . . = 11.5%
Equivalent rate of return before taxes . . . . . = 23.0%

*True Rate of Return after Taxes is based on:
12-17-yr life of new machine
Accelerated depreciation for tax purposes
New machine to be worth 15% of original cost when it's eventually replaced
Deterioration to 75% efficiency in 15 years
Nominal present market value for machines being replaced

#Investment return is usually considered before taxes. This is the return from the machine tool investment to compare with the before-tax return of other investments

"It takes too much time to work out the detailed calculation."

ADJUSTMENTS FOR OFF-STANDARD CASES

Add to or subtract from True Rate of Return after Taxes as indicated

True Rate of Return After Taxes	Different length of life of new machine		Different depreciation	Different "end of life" value of new machine		Different rate of declining earnings because of new machine deterioration			No Present market value for machines being replaced
	Under 8-11 yr life	$10,000 machines with Over $50,000 machines with more than 17 yr life	Straight line depreciation	Final value 5% of original cost	Final value 25% of original cost	50% of "normal" deterioration	150% of "normal" deterioration	Straight line deterioration	
30%	−0.5%	0%	−2%	+0.5%	−0.5%	+0.5%	−0.5%	−0.5%	−1%
27	−0.5	0	−2	+0.5	−0.5	+0.5	−0.5	−0.5	−1
24	−0.5	0	−2	+0.5	−0.5	+0.5	−0.5	−0.5	−1
21	−1	0	−2	+0.5	−0.5	+0.5	−0.5	−0.5	−1
18	−1	0	−1.5	+0.5	−0.5	+0.5	−0.5	−0.5	−1
15	−1.5	0	−1.5	+0.25	−0.5	+0.5	−0.5	−0.5	−1
13	−2	0	−1	+0.25	−0.25	+0.5	−0.5	−0.5	−1
11.5	−2	+0.5	−1	+0.25	−0.25	+0.5	−0.5	−0.5	−1
10	−2	+0.5	−1	+0.25	0	+1	−0.5	−0.5	−1
8.5	−2	+1	−0.5	0	0	+1	−0.5	−0.5	−1
7	−2	+1	−0.5	0	0	+1	−0.5	−0.5	−1
5.5	−2.5	+1	−0.5	0	0	+1	−0.5	−0.5	−1
4	−4	+1	−0.5	0	0	+0.5	−0.5	−0.5	−1
3	−3	+1	−0.5	0	+0.25	+0.5	−0.5	−0.25	−1
2.25	−2.25	+0.75	−0.5	0	+0.25	+0.75	−0.75	−0.25	−1
1.5	−1.5	+0.75	−0.25	0	+0.5	+0.75	−1.5	−0.5	−1.5
0	0	+1.5	0	0	+1	+1.5	0	0	0
0	0	+0.5	0	0	0	+0.75	0	0	0

Figure 2

Rate of Return after Taxes. This is the one significant figure we've been after.

True Rate of Return after Taxes is the return on our investment after allowing for all peculiarities of machine tools—deterioration, obsolescence, machine life, depreciation and taxes. It is a return, then, that can properly be compared with return from other kinds of investments.

Since investments are often compared on a before-tax basis, the table contains a final right-hand column, **Equivalent Rate of Return before Taxes.** This is the proper return on the machine tool investment to compare with the before-tax return on other investments. It considers the peculiar tax advantage, through depreciation, available with machine tools.

For example, a $20,000 investment with $4,000 first-year earnings has a 20% gross first year return ($4,000 ÷ $20,000), an 11.5% true rate of return after taxes, and a 23% equivalent rate of return before taxes. This 23% can be compared with the before-tax return of other kinds of investments.

Machine Tools Are Good Investments

On this basis, machine tool investments are earning more money than many have realized! We don't normally think of a "10-yr payoff" as being much of a machine investment, but this may now be viewed in a different light. A 10% first-year gross return (10-yr payoff) is actually a 4% after tax and an 8% equivalent before-tax return. There are times when a machine tool with an 8% return will be a much safer and better investment than some of the 8% return investments available elsewhere.

A Standard Pattern Of Results

Where do we get this simple table?

It is not the result of a formula. It's the actual recorded pattern of the answers from many dozens of trial replacement calculations similar to the longhand calculation from the last chapter. These calculations have been solved for different kinds and prices of machine

tools, different rates of first-year earnings, different lengths of life for the new machine, different depreciation methods, different end of life values for the new machine, different rates of deterioration of the new machine, differences in the loss of market value of the old equipment if it is *not* replaced, and for combinations of these differences.

Make all of these calculations, and you'll find that the answers fall into a definite and simple pattern such as shown in the table, and that the rate of first-year earnings is the only thing that changes the answer to a great extent.

To determine this pattern, we can establish a set of standard conditions of machine tool life, and work out a set of answers based on these conditions. We can also show how much difference (or how little difference) a deviation will make in any given situation.

These standard conditions are stated at the bottom of Fig. 1, and the effect of deviations from standard is shown in Fig. 2. Here are the conditions.

Length Of New Machine Life

The first condition is that the average machine tool—exclusive of specials, and with a price somewhere between $10,000 and $50,000—will have an expected life of 12 to 17 yrs. The standard rate of return table is based on a 15-yr life, but will solve with reasonable accuracy for the 5-yr spread.

We know from Chapter IV that large expensive machines tend to have long lives, and inexpensive machines short lives, so our "average" won't hold true in all cases. Fig. 2 shows the amount to subtract from the **True Rate of Return before Taxes** for short life "under $10,000" machines, and the amount to add for long life "over $50,000" machines. A 15% true rate of return, for instance, becomes 13.5% for short-lived machines.

The $10,000 and $50,000 figures are meant only as suggestions. Some $8000 machines will have 15-yr lives, and some expensive machines short lives. However, the dollar value is a good indication of expected machine life.

The short-life figure can include 8 to 11-yr life machines, and the long-life figure anything over 17 yrs. For anything less than an 8-yr life, work the problem out longhand. The table won't solve it.

Depreciation Methods

The standard table is based on sum-of-the-digits accelerated depreciation, and on a tax life equal to the expected machine life. Double-declining balance depreciation gives the same answers.

If your company uses straight line depreciation—an equal amount of depreciation every year—you might want to subtract from your earnings as indicated. The difference is not great, especially in the lower earnings percentages.

"In almost all cases, the standard rate of return table, without adjustment, will solve your problem."

New Machine's Value At End Of Its Life

You will remember from the sample longhand calculation of the last chapter that we can take credit for any market value our investment will still have at the end of its life. In the calculations making up the table, this value has been estimated as 15% of original cost.

In my experience this is a good average. You may feel differently. If so, you'll see from Fig. 2 that it makes very little difference. A **5% "end-of-life" value actually** tends to improve the real earnings if we reflect it properly in an accelerated depreciation schedule.

New Machine Deterioration

In our longhand calculation, we reduced the new machine's earnings each succeeding year by an amount of dollars representing the machine's loss of efficiency through deterioration. In our example, we deducted slowly in the first few years but at an increasing annual rate until by the 15th year we deducted $2000 from the first year savings figure.

This amount is based on the supposition that a machine tool will be operating at about 75% of its original efficiency after 15 years' use. At $4.30/hr (Chap. IV) this becomes $2000 per year on a single-shift basis.

It also assumes that the effect of wear on slides, lead screws, etc., will be lower in the first few years and in the very late years after a machine has already lost its accuracy.

Obviously, these are only estimates, but they're based on many years of observation of many types of machines at many different companies. If you disagree with this as an average, Fig. 2 shows adjustments to make if you think the "normal" represents too much deterioration, or not enough, or if you think actual deterioration will be in a straight line.

We can be thankful that it makes such little difference in our answer because we'll never be able to know this figure exactly even **after** it happens, to say nothing of looking 15 yrs into the future! We can only use our best judgment.

Far more importantly, when you're making your calculation, make sure your savings figures reflect deterioration of the old machines somewhere near the figure you use for the new machine's future deterioration, not merely a few hundred dollars for scrap, maintenance and downtime.

Loss In Market Value Of Machines Being Replaced

Since this is a **replacement** calculation, we can assume that the machines we're replacing have some value in the open market, and that if we don't replace them now their value will be less at this time next year. In the last chapter's example, we took a $400 annual "freeze credit" for avoiding this loss if we buy the new machine.

"Learn to use round figures."

If the replaced machines have only scrap value, or **if our calculation is for a new machine that is not replacing an old one,** we can adjust as shown in the far right-hand column of Fig. 2. Subtract one point — not a significant amount in the higher earnings brackets.

Use The Standard Table

In almost all cases, the standard rate of return table, without adjustment, will solve your problem more accurately than you can determine first year earnings. The various adjustments have been shown so that they can be used when necessary, but also to show what little difference they actually make! Proper perspective and judgment in the using of any of the figures is far more important than improving the accuracy of the Rate of Return Table.

As a matter of fact, the arithmetical answer that we now have can be worse than useless if it doesn't reflect, as near as we can make our estimates, the true values that we're trying to measure. Here are some points, covered in previous chapters, to keep in mind.

Keys To Successful Replacement Calculations

Learn to use round figures. The mere fact of finding certain values to the nearest dollar closes our mind to the $1000 we can easily be off in other measurements. (Chap. I).

Don't expect to "prove" all savings. "Proving" doesn't guard against fudging the answer, it merely closes out a lot of values that belong in the calculation. (Chap. II)

Realize the deterioration can't always be measured by scrap, maintenance and downtime. Be willing to estimate. (Chap. III)

Include a proper percentage of overhead costs in the dollar value of the man-hour. (Chap. IV)

Avoid arbitrary "return" requirements that make the "buy" or "don't buy" decision without regard to factors the calculation can't handle. (Chap. V)

Compare the risk and human factors involved in the investment. Some apparent 6% "returns" may be better investments than 18% or 20% opportunities. (Chap. V)

Finally, remember that your judgment as shop manager is the most important element in equipment replacement. You should not fail to exercise it, nor should your company fail to rely on it, just as they rely on it in other ways every day.

The use of this judgment in various replacement situations will be the subject matter of the next, and final chapter as we show by examples how the principles discussed in these chapters can be applied. ■

Editor's Note: For your convenience in putting Mr. Fullerton's quick calculation method into practice, we will furnish a reprint of Figure 1, The Rate of Return Table, and Figure 2, Adjustments for Off-Standard Cases. This will be on heavy paper stock suitable for desk top or wall mounting. It will show instructions for using the Tables as well as the Keys to Successful Replacement Calculations. *For your copy, circle Inform-A-Gram Card No. D1.*

Redesigning Payoff

Turning of a drum, as shown, is handled on a DeVlieg Jigmil as a boring operation, now a 13 min job — formerly a 4 to 5 hr lathe operation. A combination Microbore tool does the turning, as well as facing and centering required. Only one setup is involved, with the work simply being turned on the table, after the first end is completely machined.

Besides helping hold down the overall price of the Jigmil, redesigning the turret assembly in aluminum opens up a new area of flexibility for Jigmil users. The turret assembly is, in effect, a memory element for depth control of the spindle and rapid traverse. It's light enough and low enough in costs, that with spares, a user can leave the multiple dogs set up, and simply switch drums, rather than to reset dogs.

Hold Optimum Tool Grinds ...Infinitely

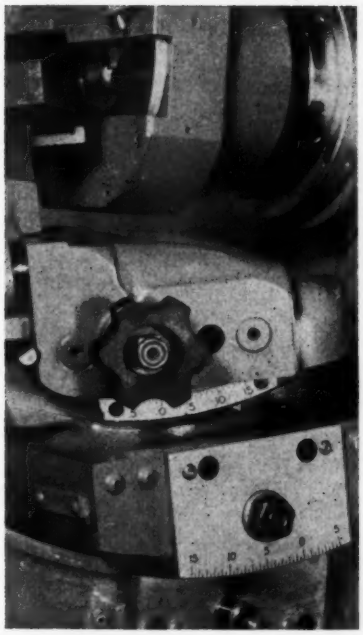


Fig. 1 Protractors which enable Micropoint to grind and repeat either cylindrical or conical tool nose forms accurately.

SLIGHT VARIATIONS in geometry of a tool point can produce substantial variations in tool life and performance. Although there are parameter to guide him, it is doubtful that there exists a cutting tool engineer who will claim ability to design optimum tool geometry for any job which he encounters. So what do we do? We "cut and try," to arrive at a tool grind which seems to do the job best. But what do we do when this tool needs resharpening? The man in the toolroom is, at this point, handicapped similarly to the tool engineer. He has "guide lines," but essentially must rely on his skill and experience to reproduce the successful set of geometric characteristics.

To build a hypothetical example upon experimentally - established data, suppose the successful tool had an 8° relief angle, among other characteristics. In resharpening, everything is maintained (a good trick, by conventional methods) but the relief angle, which is now 10°. This slight change in one geometric characteristic rendered the tool capable of producing only 52% as many good parts before regrind was again necessary.

Fig. 2 Integral Micropoint protractor permits control of relief angle within 0.5°.

The DeVlieg Machine Co., Royal Oak, Mich., appears to have solved this problem, as well as some related ones, by the release of their Micropoint Tool Grinder. This is a rigid machine tool designed specifically for grinding cutting tools. Salient is the angularly adjustable tool stand. Through the use of built-in protractors, the nose radius and other critical characteristics desired can be set very closely, for translation to the cutting point. Because of the protractors, these characteristics can be recorded. If deemed optimum for the job at hand, they can be reproduced infinitely by adjusting the tool stand to cause the desired values to reappear on the protractors when sharpening or renewing that particular tool.

It is further reported that the tool nose can be given either cylindrical or conical form, and a smooth, constant nose radius is generated. For further information on the Micropoint, write DeVlieg Machine Co., Fair St., Royal Oak, Mich., or circle Inform-A-Gram No. D2.

Precison Bending

Machine writes own program . . . then goes into production

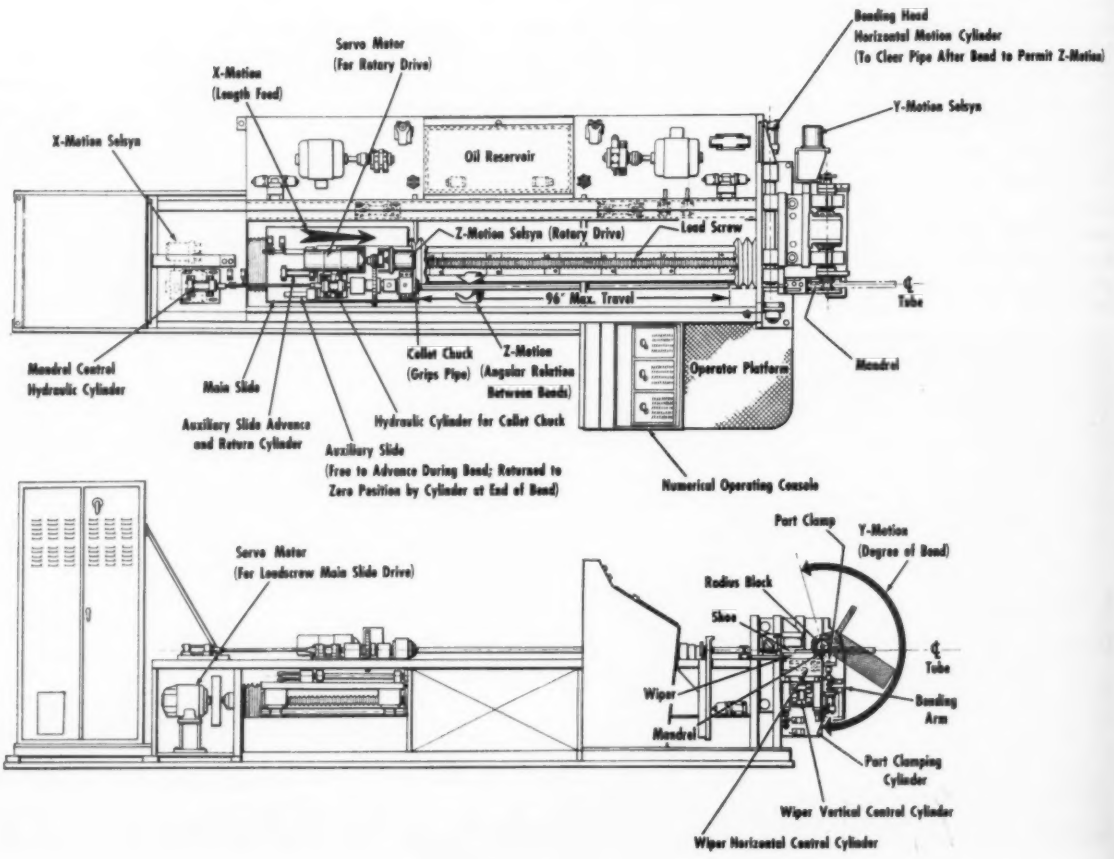
BEND-O-MATIC, recently introduced to industry for accurate aircraft-quality bending, handles tubing up to 1¼" dia and 8" long.

After much success with a bending machine of a different concept (for automotive tail pipes), the Nu-Era Corporation, Detroit, contracted with Walter P. Hill, Inc. to build this one for precision work. It will handle any material on a repeat basis with high fidelity and to unusual tolerances.

Complete change-over from one production pattern to another can be made in 35 min, a fraction of the time required for conventional machines. And it takes the standard tooling being used in other bending machines.

Numerically Controlled

The General Electric Mark III numerical control package automatically controls the collet chuck to clamp the end of the tube. It also feeds out the proper length of stock needed for each bend, directs tube rotation, carries the



program for the amount of bend, and controls the movement of the mandrel (in the tube) during bending. Each successive bend is sequence programmed in this manner.

Autoprogrammer

To save planning time, the GE control includes an autoprogrammer which allows the operator to make the first part by insertion of a numerical-proposal into the decade keyboard. He makes trial bends until they are correct. Then he pushes a button that automatically punches a tape with the final keyboard reading. From the tape, exact duplicates of the "prototype" part can be made on a production basis.

In production the tube is manually inserted through the bending arm over a mandrel and into the collet. After loading, the "cycle start" button is depressed and the machine automatically advances tube, twists it and makes the bend. Each successive bend is performed one after the other until the tube is completely bent. At the end of the cycle the machine automatically unclamps and the main slide returns to "cycle start" position.

Bending is smooth and continuous without surface stress. Use of a proper sized mandrel for internal support prevents tube collapse.

Further Specs

Main slide travel is 359.99″ repeatable within ±0.005, while a rotation of 360° is possible, repeatable within ±0.05°. A maximum bend rotation of 189° can be made within ±0.05°. Circle Inform-A-Gram No. D3.

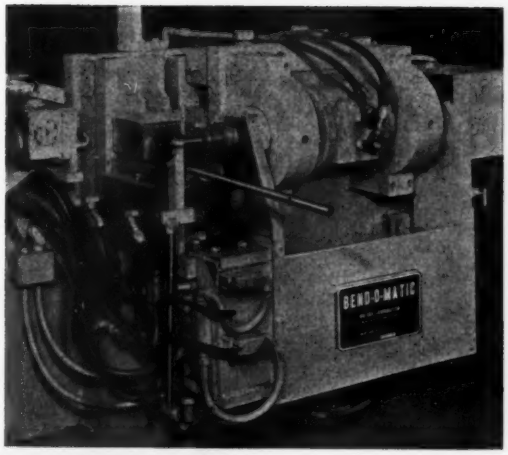


Fig. 1 Main slide has advanced to position tube for first bend.

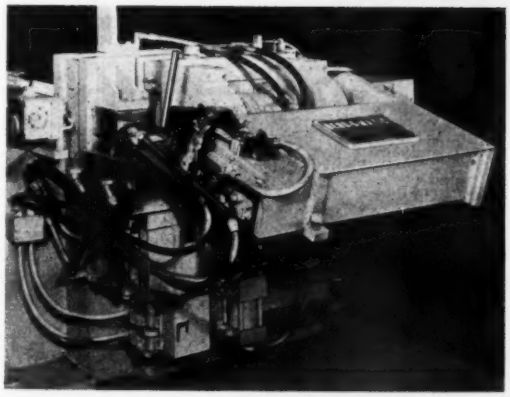


Fig. 2. Bending arm has rotated and made the first bend.

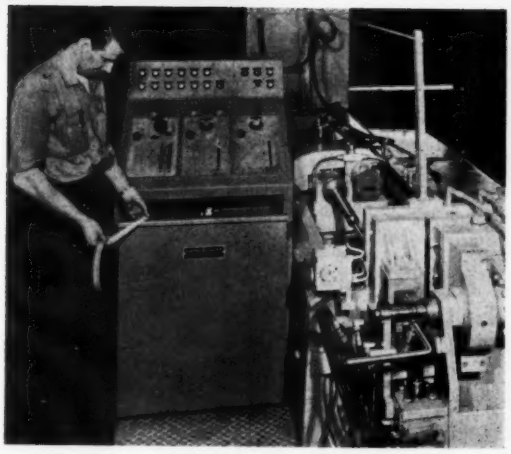


Fig. 3. Tube has been advanced once again and twisted 90° to the left. It is now in position for second bend.

A Treasury of Tooling Tips

AIDS TO MACHINE SHOP PRACTICE, by C. T. Bower. Published by The Macmillan Co., 60 Fifth Ave., New York 11, N.Y., 1961, 208 pages, $4.50.

Mr. Bower, production engineering writer with experience in both Great Britain and the U.S., most lucidly outlines his text in his foreword: "The subjects dealt with in this book can be broadly defined as jigs, tools, fixtures, machine tool attachments and workshop methods. It is hoped that production engineers, shop foremen and operators of small machine shops will accept this as a reference work of practical value, while jig and tool draftsmen should find in it some novel and worthwhile ideas in machining methods."

The ideas set forth were originally published in England as a popular series in Machine Shop Magazine. In sum, a good little show.

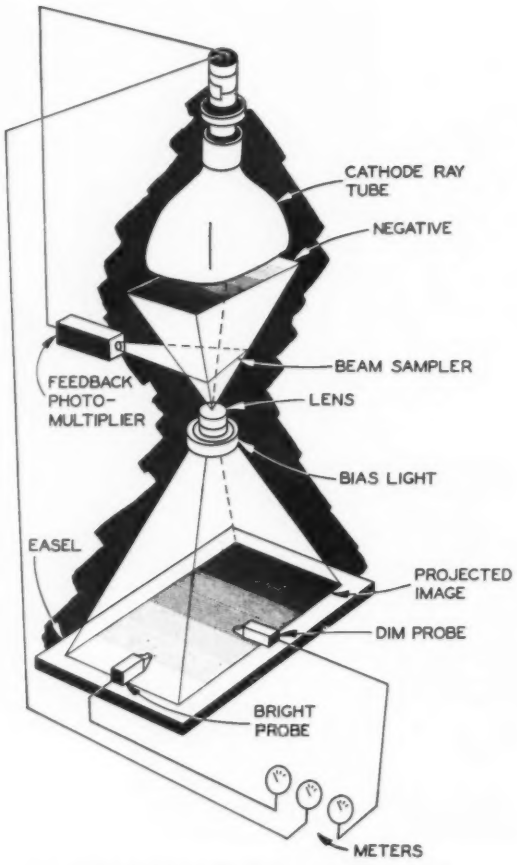


Fig. 1 Schematic illustration of principles of LogEtron electronic photodrawing device.

PHOTODRAWING is receiving more and more recognition as a cost-cutter, having demonstrated reductions in drafting time as great as 350%. In addition, the advantages arising from minimum delay are obvious, especially to those who have had to "stop everything" pending publication of needed prints.

Heretofore, however, photodrawing has suffered from two serious drawbacks. One of these was that lighting usually cannot be made perfect and uniform on all areas and surfaces of the device to be photographed. This has caused a muting, or complete loss, of some important details in the photograph. Another handicap was that inherent detail loss was exaggerated by reproduction of the photodrawing through standard diazo machines.

LogEtronics, Inc., Alexandria, Va., has devised means of combating both of these handicaps. A high quality original photograph is a prerequisite. Strong contrast must be avoided, and the view must be composed so that the quantity of included detail will not smother individual details.

The next step is transferal of the photo image from the original neg-

Photodrawing Advances Through New Techniques

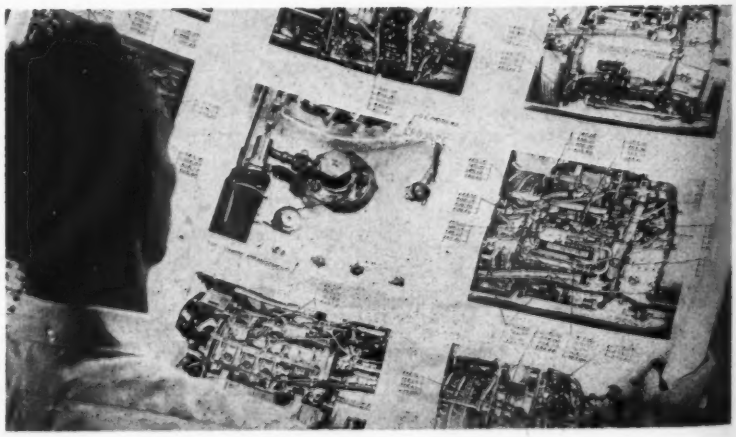


Fig. 2 Large composite assembly drawing of jet engine. Drafting time by conventional methods 600 hrs; by photodrawing 30 hrs.

ative to a transparent positive. This is where the LogEtron comes into play. This is an enlarger complex which electronically compensates for imperfectly exposed areas of the negative and permits the production of a more nearly perfect transparency. LogEtronics produces sharp, clear copies by placing a halftone screen between the photodrawing and the photosensitive paper. This prevents the diazo from exaggerating contrast, and produces a photoprint composed of clear images much like those of the illustrations in this magazine.

The finished photodrawing master is so laid out that the necessary labels, instructions, and other notes are easily applied by the draftsman. He adds dimensions, hidden lines, etc. as required. The LogEtron is much like any standard photo enlarger, but is definitely a sophisticated one. Instead of a conventional light source, the LogEtron features a cathode ray tube. A moving spot of light, projected from the tube, is continuously and automatically varied in brightness by feedback from a photomultiplier tube below the negative as it makes the exposure. Two sensitive light probes at the easel permit the operator to control image brightness range and contrast to match precisely the emulsion on which he is printing. The variable brightness of the light source automatically exposes each detail of the picture to bring out full shadow, midtone, and highlight detail.

Inasmuch as the device to be photodrawn must already be in existence, it may at first appear that the opportunities to realize the savings offered are quite restricted. This is a deception. Hand-built prototypes, mock-ups, and appearance models (even small ones) are common, and lend themselves excellently to photodrawing. Another of the many applications for this technique is the planning and execution of revision or redesign of existing products. ■

Following is a conclusion of a hypothetical calculation analyzing the comparative costs between producing assembly drawings by conventional drafting techniques and by LogEtronic photodrawing. With savings of approximately 60 hrs per assembly drawing (72%), one large project of 50 drawings would offer potential time savings of approximately 1½ man-years. This means earlier delivery dates with less manpower.

Cost Saving Conclusion:

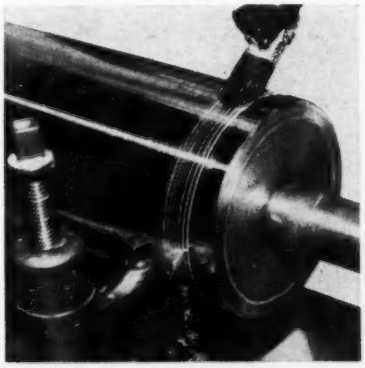
	Conventional Drafting	LogEtronic Photodrawing
A. Assume $3.50 hourly drafting rate:		
Total Cost Per Drawing	$ 291.20	$ 84.00
Total Cost for 50 Drawings	14,560.00	4,200.00
Net Cost Savings by Photodrawing		$10,360.00
B. Assume $8.00 hourly drafting rate:		
Total Cost Per Drawing	$ 665.60	$ 177.60
Total Cost for 50 Drawings	33,280.00	8,880.00
Net Cost Saving by Photodrawing		$24,400.00

Diamond Turns Out A Smooth Finish

A super finish is assured on non-ferrous metals with the use of single point diamond cutting tools. Copper and zinc faced printing rolls, cylinders and mills for photographic equipment are finished to a very high degree of smoothness and parallelism with a minimum of machining time and a substantial savings in material costs.

The illustration shows a diamond tool turning a printing gravure to a one micro finish in one pass of the tool. All roughness, surface blemishes, scratches or high spots were removed, since this surface must be flawless in metal grain structure for a high quality, precision printing process.

Workpiece concentricity is held to 0.001 over 30″ of length with a tool feed of approximately 0.0015 and a speed of 500 rpm. Smoothness is directly proportional to lathe speed. The speed set for this operation is the machine's maximum. Higher speeds are recommended if they can be obtained.



Diamond tipped tool turning a printing gravure for precision smoothness. White lines are cutting lubricant.

The diamond performs many operations in a single pass. No lapping, honing or polishing are necessary after this one operation.

To preserve expensive printing rolls for further production, a minimum of material is removed from the surface consistent with smoothness, and this can be done best with a diamond. Other kinds of cutting tools require the rolls to be rough cut, finish cut, lapped, and sometimes polished.

Diamonds are also being used for boring of thin-walled aluminum tubing. The minimum of pressure prevents the tube wall from collapsing — a problem ordinarily experienced with other types of cutting tools.

The diamond tool gives consistent performance with a high degree of accuracy without tool changes or replacement, even on long production runs. The right kind of diamond, used at much higher speeds than required for other tools, can save considerable production time.

Rubber composition rolls, paper mill cylinders, hard fibrous materials, precision machining parts, optical and instrument parts are better machined at less cost with a diamond tipped tool.

Self-Broaching Fastener Solves A Sealing Problem

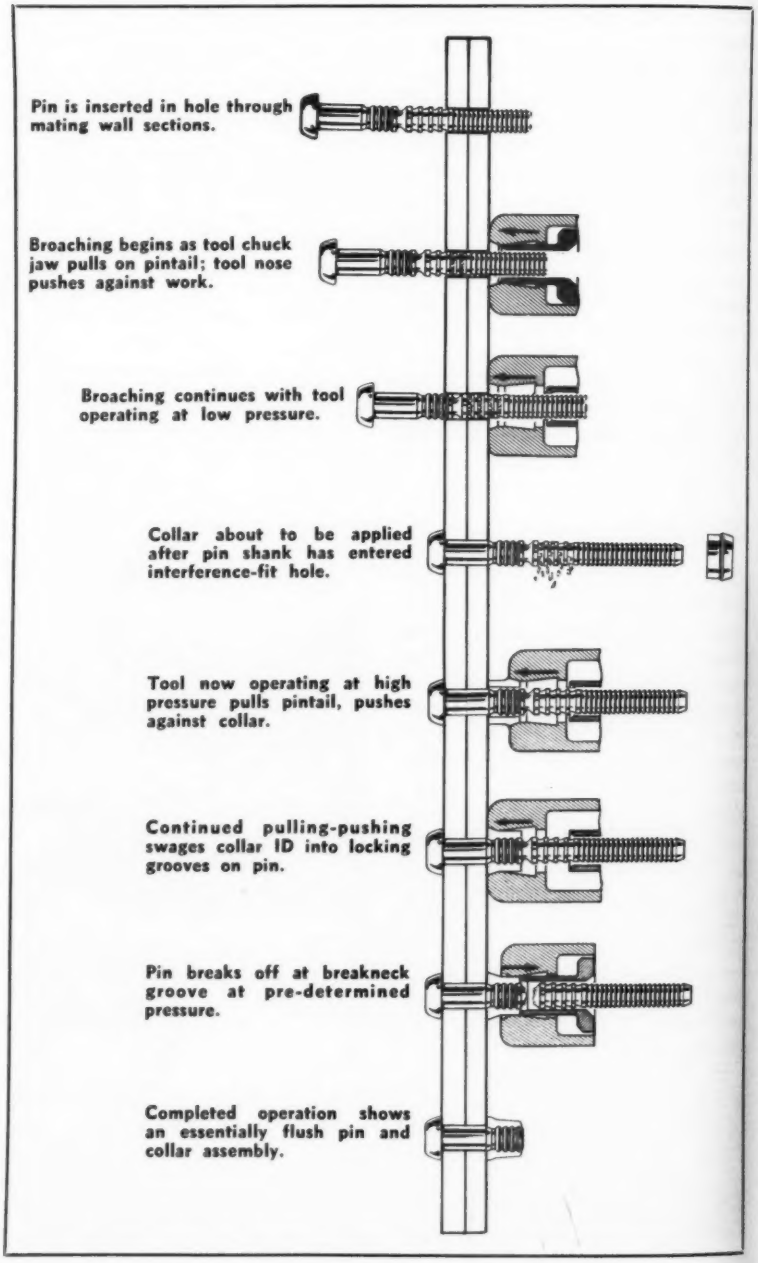
"FOR THE WANT of a nail, a shoe was lost," begins an old proverb illustrating the axiom that attention to the most minute detail is imperative in a tactical situation.

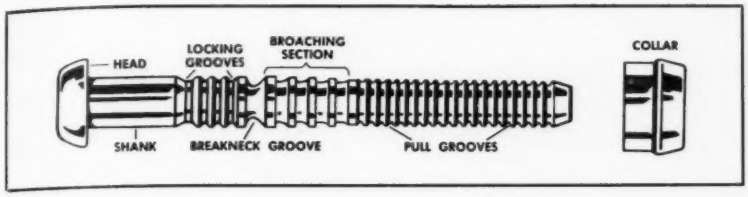
For the want of a reliable fastener, precious lives, an expensive missile, or costly liquid oxygen fuel might sometimes be lost if Douglas Aircraft Co. and Huck Mfg. Co. engineers hadn't teamed to produce that reliable fastener.

Douglas builds the Air Force's Thor ICBM at its Santa Monica, Calif., installation. Huck Mfg. Co. supplies close-tolerance Huckbolt fasteners for the job. The latter firm recently introduced a new self-broaching model to solve a ticklish sealing problem in the missile's liquid oxygen fuel compartment.

A leakproof fuel chamber is a must on the Thor. Liquid oxygen may react violently when brought in contact with elements contained in many lubricants and sealants. Contamination could result in premature firing or other hazards. To preclude contamination possibilities, the self-broaching fastener is installed "dry." No lubricant or sealant is used on either the pin or the fuel compartment surfaces.

The new pin evolved this way. In seeking a simple means to achieve positive, controlled interference-fit installation of Huckbolt fasteners for the DC-8 commercial jet transport, Douglas engineers considered applying broaching teeth to the pin. This was a logical


Pin is inserted in hole through mating wall sections.
Broaching begins as tool chuck jaw pulls on pintail; tool nose pushes against work.
Broaching continues with tool operating at low pressure.
Collar about to be applied after pin shank has entered interference-fit hole.
Tool now operating at high pressure pulls pintail, pushes against collar.
Continued pulling-pushing swages collar ID into locking grooves on pin.
Pin breaks off at breakneck groove at pre-determined pressure.
Completed operation shows an essentially flush pin and collar assembly.



Profile of self-broaching fastener and collar.

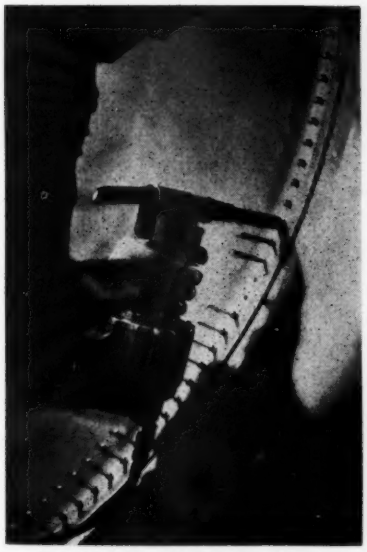
approach, since both the broaching operation and fastener installation involve a "pull-through" action. By making a broach of the fastener, finish broaching could be accomplished automatically and simultaneously with the installation of the fastener.

Douglas patented and tested the self-broaching fastener, then turned the production project over to Huck to perfect. The unique pin was developed in time to use it in the Thor program.

Not only does the new pin produce a joint equivalent in tensile, shear and fatigue strength to the best achieved with conventional close-tolerance fasteners, but it also produces optimum interference fit (within 0.0005 to 0.002) more easily. Selective matching of pins to holes is not required. Since the fastener itself determines the control of fit between pin and hole, close-tolerance drilled holes are sufficiently accurate. The former finish ream operation is eliminated.

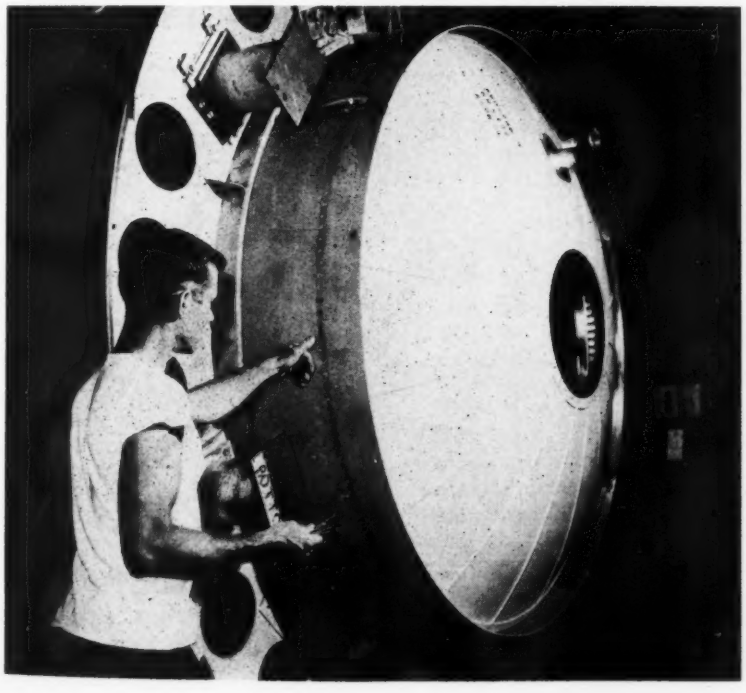
In addition, the self-broaching fastener generally produces a better finish on the hole than would be achieved with finish reaming. This is because broaching is now a "one shot" proposition. The integral broach section on the Huckbolt pin is used to machine only one hole.

The self-broaching pin is installed with a "double-driving" technique. Thus, the pin is first pulled into the hole and fully seated before its collar is applied. The hole is broached by pulling the AISI 4037 steel pin through with the installation tool set for low-pressure operation. After the pin is fully seated, the tool is removed, and the collar slipped over the pintail projecting into the fuel compartment's interior. The tool is applied at high pressure, and the collar is swaged into locking grooves on the pin. Continued pulling at this point causes the pintail to break at a predetermined force, leaving the pin essentially flush with the collar. The collar occasionally requires some lubrication. In these instances, a lubricant compatible with liquid oxygen is used.



Finishing the pull-through, broaching, and collar swaging operation from inside the fuel chamber.

Pin is inserted through outside wall of missile's fuel chamber.



Broach diameter is held during manufacture within 0.0005 to 0.002 less than pin shank diameter. Tolerances and standards maintained during Thor production insure a precise fit within +0.00075. The mechanical seal thus produced is the most effective means yet found to resist forces imposed by the fuel load carried by the Thor.

A war was lost in the old proverb, "all for the want of a horseshoe nail." The Thor, hopefully, will never be used in war, but it must be tested toward that end. The chance of life and money loss has been considerably lessened because engineers met the want for a reliable fastener. ■

Fig. 1 Chip shower on Onsrud spar mill machining an aluminum bar at 300 ipm. Four cutters remove 1760 cu in/min, with all four drive motors at maximum (320 hp total).

High Speed Machining ready for new horizons

INCREASED COMPETITION in metalworking has teamed up with accelerated machine tool and cutting tool development to generate an increasing usage of high speed machining techniques to produce non-ferrous products. The light alloys, especially, are being worked at fabulous rates, thus holding their own costwise against the often more attractive physicals of the newer exotic metals in aircraft.

Beginning before World War I, high speed machining has thoroughly proved itself as a means of low cost production with assured good finish and close tolerance. Airframe and related industries are still large users, but many manufacturers of appliances, outboard motors, furniture, and other products have been lured by the substantial gains in machining rates . . . and lower manufacturing costs over-all.

One of the leading exponents in the drive toward higher speeds, Charles R. Onsrud, president of Onsrud Machine Works, Inc., Niles, Ill., foresees an even wider adoption of high speed metal removal. Pioneering in the introduction and development of such machining for the past 25 yrs, the Onsrud firm is a leading supplier of machine tools specially engineered for the working of non-ferrous metals.

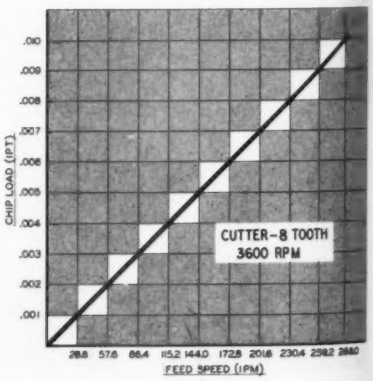
According to the company's concept, high speed machining, —in which cutter speeds range from 5000 to 10,000 sfpm—requires spindle speeds from 1800 to 100,000 rpm. High cutter speeds demand proportionately high feeds to maintain an effective chip load on each cutter tooth.

For example, a 6.00 dia, 8 tooth cutter, when run at 3600 rpm, cuts a chip 28,800 times/min. To achieve a chip load of 0.001 inch per tooth, a feed of 28.8 ipm is required. A 0.010 ipt chip load requires a feed of 288 ipm. (See graph.) The maximum chip thickness depends on surface condition desired, and capabilities of the machine and its tooling.

There are, of course, practical limitations to the cutting speed. As speed increases, cutter balance and rigidity of machine and tooling become more critical. Observations of Onsrud engineers on some of the factors involved are reported in following paragraphs.

How Good Is Tool Life?

Tool life depends on such variables as the material being cut, geometry of the cutting edge, method of applying lubricant to cutter, thickness of chip per cutter tooth, grade of carbide cutting ma-



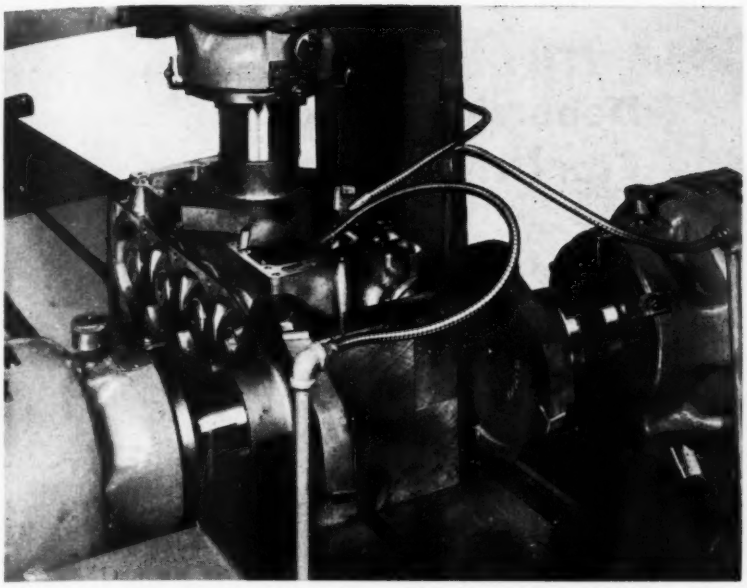


Fig. 2 This Onsrud Triway Mill cuts three faces of an aluminum engine block simultaneously at 100 ipm.

Fig. 3 Aluminum die castings are face milled at 720 surfaces per hr in this rotary mill. Cutter speed is about 10,000 sfpm, feed about 150 ipm.

terial, and—most importantly in high speed machining—cutter balance, and the rigidity of machine and of workholding fixture.

A cutter for high speed machining can provide a life equal to, or better than, that of a cutter made for conventional feeds and speeds. Tool life should be measured by the number of pieces produced per cutter grind, not by the period of time that the cutter is working. The vast difference in production does not make time a proper basis for comparison.

But too often, cutter life is overemphasized. Since parts can be produced so much faster, the savings in production time make cutter grind life less important from a cost standpoint. A portion of the time savings can be wisely reinvested in better tools and in their better care and grinding. The result is improved finishes and reduced loss of machine time for tool changes.

Limitation of Heat and Heat Transfer

Heat is no great problem when machining at high speeds because it is removed almost as fast as it is generated. The cutter is sometimes running 10 times faster than conventional speeds. The usually smaller chip load per tooth limits the heat generated, but the major factor is the short duration of contact between chip and cutter. The chip hardly has time to transfer its heat into the cutting edge before it is thrown clear.

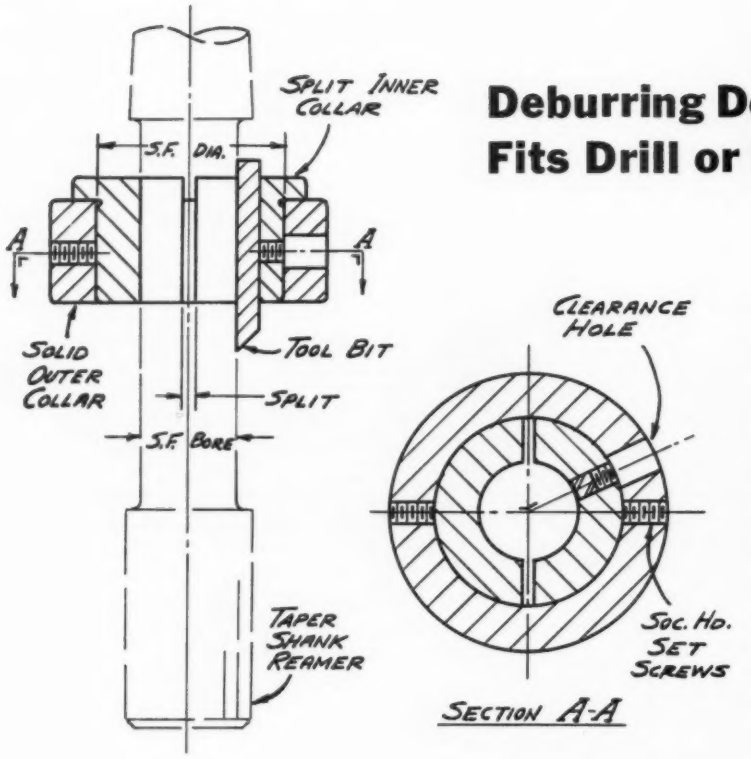
Even though the chip is moving so fast, chip breakers are used extensively to break up the hot chip and get rid of it quickly .

Fig. 4 Rotary milling produces this missile ring 15 times faster than single point machining.

A coolant is often used primarily to carry the heat out of the chip. Instead a coolant should be thought of to reduce the friction between chip and tool face. It also acts as an insulator—to reduce heat transfer from chip to tool.

The best method to apply coolant is to use small high-pressure jets spraying at the cutting edges from several points around the cutter periphery. A pressurized mist-coolant system is best, be-

Deburring Device Fits Drill or Reamer



DEBURRING IS ESSENTIAL after drilling and reaming most holes. Standard tools — commercially available for this purpose—are usually used in individual operations. However, when large numbers of holes require deburring, chamfering or special edge finishing, here's a home-made specialty that pays real production dividends. Used in conjunction with the drill or reamer, the separate operation can often be eliminated.

This idea has been successfully applied in heat exchanger work. In one case, more than 20,000 holes were chamfered in this manner in four large tube sheets.

Details of the cutter and split collar mounting device (made from hot or cold rolled steel bar) are shown in the drawing. Mounting the tool bit is slightly complicated when a tool (such as a taper shank reamer) has a shank section smaller than its cutting body and the taper end. (Note: On drills or straight shank tools, a single, one-piece collar can be used to mount the tool bit.)

To make a split collar mounting unit, bore the inner shouldered collar for a slip fit on the reamer's body. Then cut a keyway of proper size to fit the tool bit. Before splitting the piece, drill and tap a hole —entering the keyway. Insert a socket head set screw to fasten the tool bit. Bore the solid outer collar to a slip fit over the split member. Drill and tap two holes 180° apart to clamp the split collar by means of set screws. (Note: Use the same size tapped holes throughout; one socket wrench then handles mounting and tool bit removal.) A clearance hole drilled in the outer collar provides access to the inner set screw. This allows for tool bit removal without disassembly.

For straight deburring or chamfering, grind the tool bit for a 45° cut. For special shaped grooves (such as small radius or J-type grooves), grind the tool bit to the desired cut profile. ■

. . . High Speed Machining, from preceding page.

cause the fine spray must have sufficient velocity to pierce through the air turbulence created by the cutter running at high speeds.

The Future

There is still much room for the expansion of high speed machining, as machine and tool designers adapt the concept to other manufacturing operations. Further progress can be expected in bearings (viz. air bearings) and in drive systems, permitting even higher speeds without vibration. The cemented carbides and other cutting tool materials are certain to be improved still further, opening additional possibilities.

Just as some of the techniques and machine-building concepts were carried over from woodworking to high speed machining of nonferrous metals, so is the latter now contributing to higher rates of metal removal from steel.

According to Charles Onsrud, "We must continue to develop new methods of manufacturing more products at less cost, in order to continue to compete for world trade and to meet the competition at home from products made with low cost foreign labor." He cites high speed machining as just one big step toward reducing cost throughout industry, and reaffirms that what industry can do in the future is limited only by its own imagination. ■

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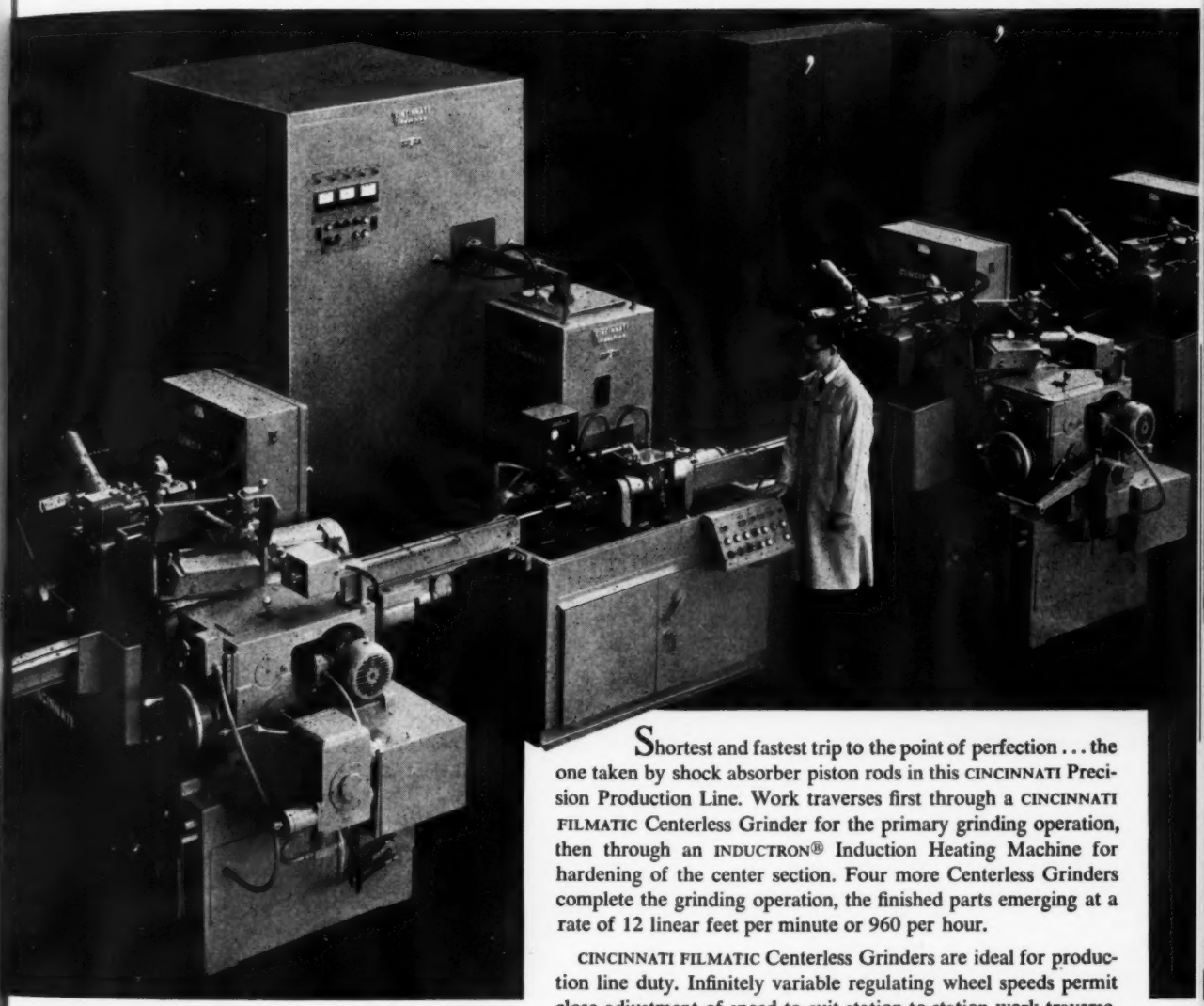

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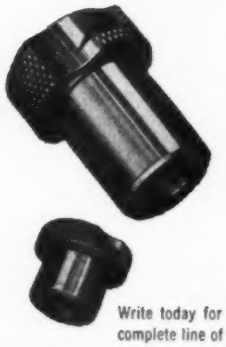

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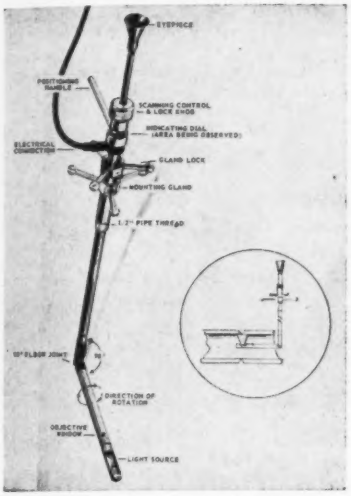
Tube Inspection Simplified

A Chicago instrument company has out-angled tooth-brushes in developing the Inspect-O-Scope, a device designed to inspect pipes, steam lines, boiler tubes, and other tubular constructions having offset entrance holes. The user may look for imperfect weld seams, obstructions, and other "hidden" defects.

Made by Size Control Co., a division of American Gage & Machine Co., the optical inspection device will enter openings as small as ½" pipe thread holes. It consists of a hinged optical section, the lower portion of which can be positioned at 90° to the entrance axis after insertion. The objective window and light source can be rotated through an arc of 360°. An indicating dial below the scanning knob accurately identifies the position of the area being observed. Calibrations on the side of the scope indicate depth of insertion.



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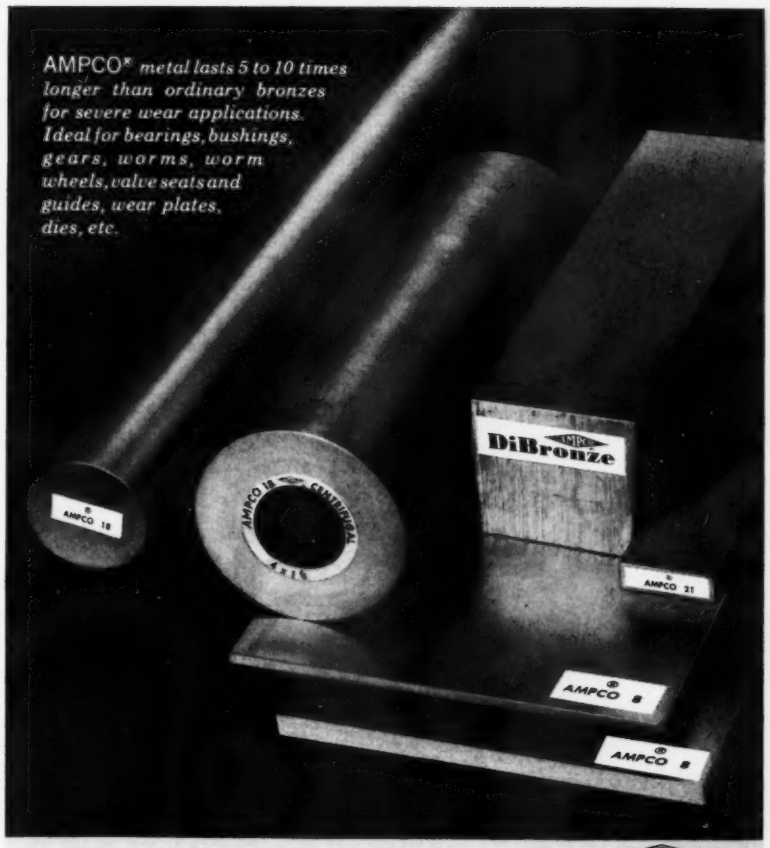
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The continuing exploration for better aircraft quality steels at A. Finkl & Sons Co., Chicago, has produced a forging die block steel which has demonstrated 24.7% longer useful life. Finkl FX Temper-1 vacuum degassed alloy steel is produced by an advanced vacuum melt process that excludes air until the steel has reached ingot form. This involves two operations of particular interest.

Alloying additives such as limestone and aluminum are released to the vacuum chamber from an air tight hopper, so that outside atmosphere cannot reach the melt. In addition to the alloying function, these additives form an insulating "skin" over the molten steel so that the ladle may be removed from the vacuum chamber without exposing the steel to atmosphere.

To maintain exclusion of atmosphere, the ingot molds are pre-

This set of FX Temper-1 die blocks produced 43,816 steering arm forgings before sinkings expanded 1/16", necessitating re-sinking; some 10,000 more forgings than could have been expected of dies from conventional steels.

filled with an inert gas, and the steel is poured through a pressurized "blanket" of the same inert gas. Studies in a large automotive forging shop showed that die blocks made from this cleaner, tougher steel are producing 24.7% more hot forgings per sinking than has been achieved by die blocks made from steel which has not been degassed.

The Management of Engineers

OPTIMUM USE OF ENGINEERING TALENT, published by the American Management Association, 1515 Broadway, New York 36, N.Y., 1961, 416 pages, $9.00. Representatives of leading companies here discuss every phase of effective engineering management —from basic objectives, responsibilities, and organization of the engineering division to recruiting and selection, compensation, supervision, professional development and evaluation.

The book is billed as "the first comprehensive analysis of the management of engineers." It treats in detail the role of the engineering manager—that of interpreting top management policy for his engineers and of informing management of progress in engineering projects. The book is most useful in showing the engineering manager how to help both top management and the engineer do a better job.

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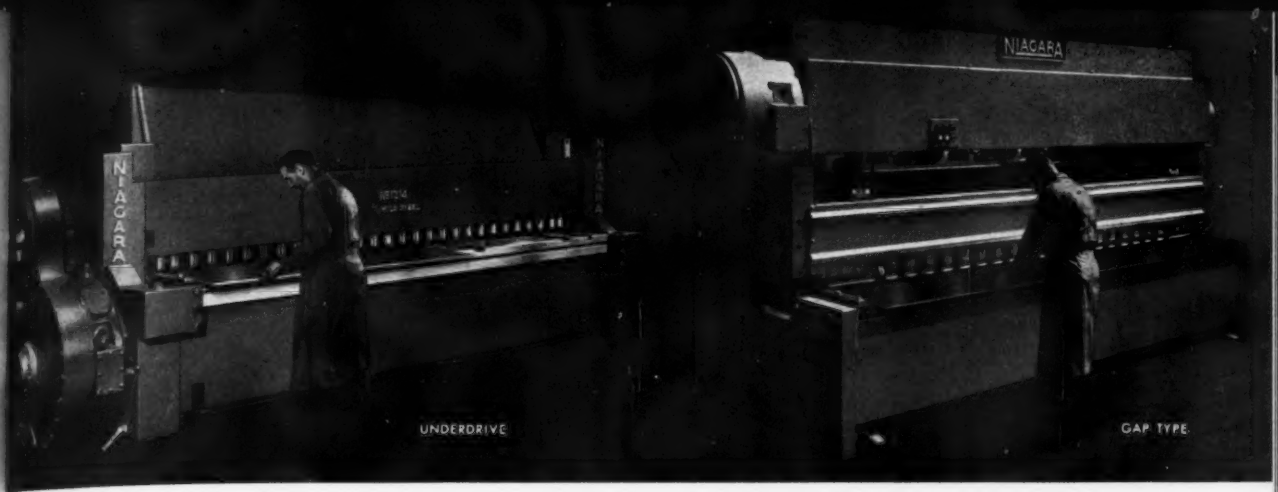

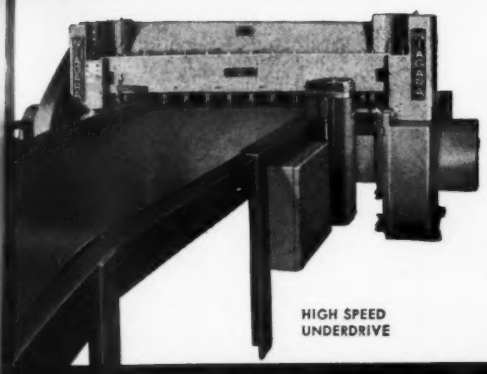

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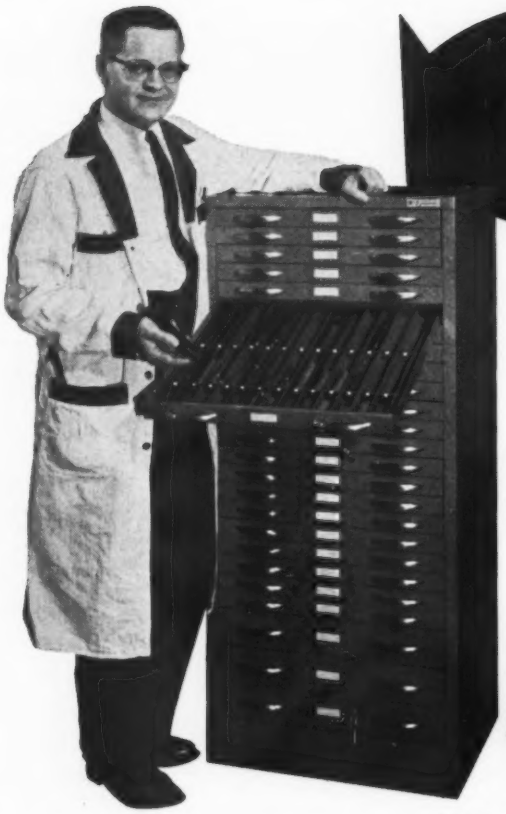

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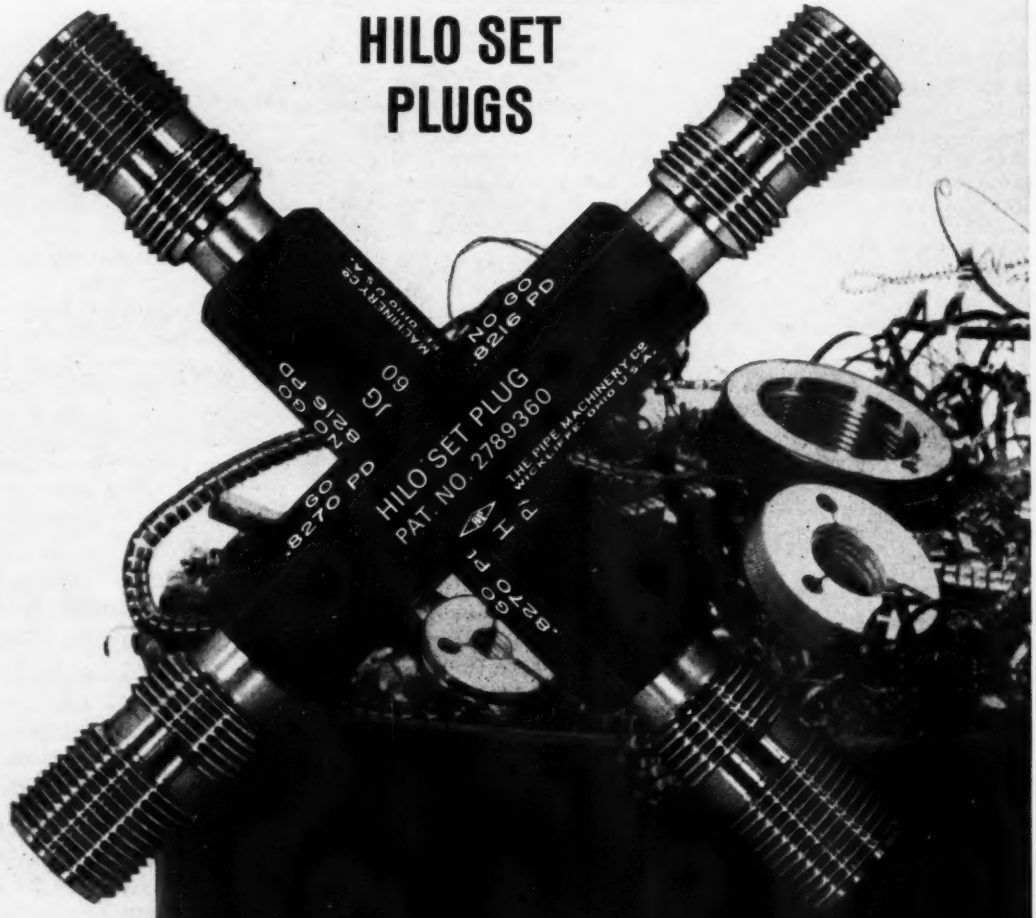

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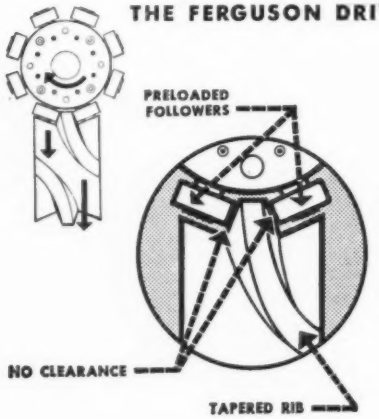

Cam features a tapered rib along which two standard cylindrical followers roll without clearance . . . *maintaining zero backlash during index and dwell.* While in the dwell or "work" position a straight portion of the cam rib locks the hub positively, without auxiliary locating or locking devices. *Extreme precision is inherent,* even at speeds as high as 2,000 indexes a minute!

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CIRCLE INFORM-A-GRAM KEY NO. 68

Bright Finishes for HSS, Tool Steels

Parts finishing before heat treating—that's a prospect often possible since Ipsen Industries, Inc., introduced a fully automatic hardening process for high speed and tool steels. The process produces a bright finish on the parts treated, maintains correct surface carbon concentration, holds distortion to a minimum, and reduces operation costs to less than half those for salt treatment, say officials of the Rockford, Ill., firm.

The basic equipment used is a modified Ipsen vacuum unit. An operator at the control cabinet sets the time at pre-heat soak and at high heat soak. After he starts the cycle, the unit will automatically perform all functions, and ring a bell to signal the operator when the work is finished.

Since the work is protected from oxygen and other oxide producers during the heat treat cycle, the surface remains clean and bright, often allowing finishing before heat treating. Also, as both work and the furnace are heated together, and parts are never moved while hot, distortion is held to a minimum.

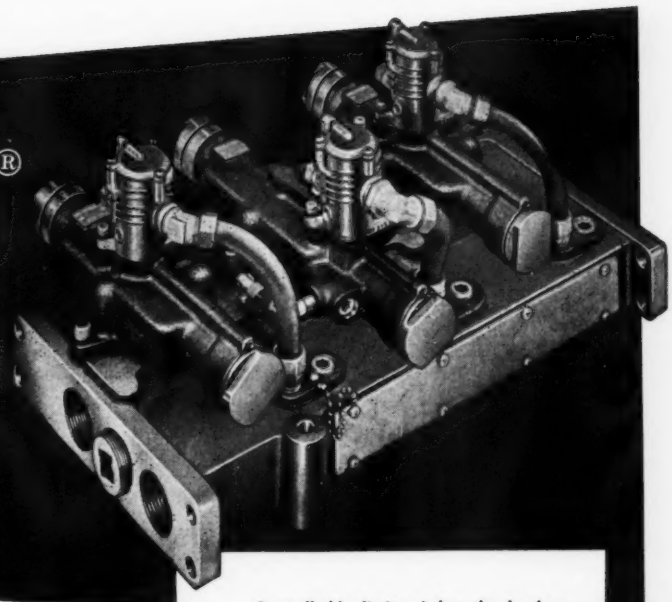
Government, Everyone's Business

Former President Dwight D. Eisenhower told a recent gathering of industrialists that whether they liked it or not, the government, because of the high tax rate, was a part of their business. He urged them to recognize this in business management, just as they would recognize the need for budgets, cost control, product research or advertising.

He also advised the group that "businessmen should volunteer their services at local, state, and federal government levels." He called for industry to "find young, personable candidates" from both political parties who stand for sound progress and "sanity in fiscal affairs."

The occasion was a meeting of the Manufacturers' Assn. of York, Pa. Gen. Eisenhower, now a Gettysburg "farmer," referred to the industrialists as his neighbors.

SPEED KING® Deceleration Manifold



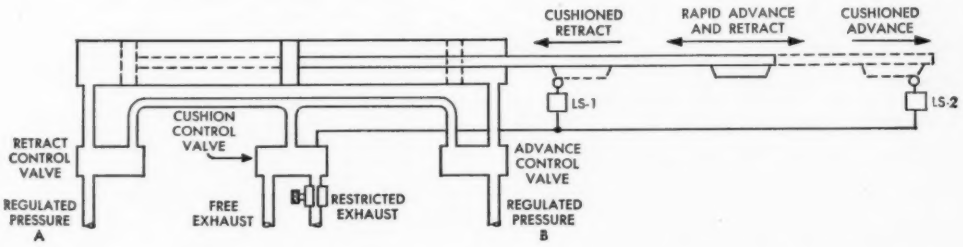
Controlled by limit switches, the deceleration unit permits rapid initial cylinder travel . . . then restricts cylinder exhaust to provide desired rate of cylinder cushioning. And, if needed, live air can be introduced momentarily to the exhaust side of the cylinder for added deceleration and cushioning.

...for positive cushioning of high speed transfer units

The Speed King deceleration manifold controls double-acting cylinders on automated equipment moving masses weighing several hundred pounds . . . where rapid travel and precise, easily regulated cushioning, at any point in either or both directions, is required.

Rapid travel keeps production rates high . . . controlled deceleration and positive cushioning prevents damage to mechanisms . . . protects valuable dies and tooling.

Your Bellows-Valvair Field Engineer can advise you on control of large, fast-moving reciprocating units. Call him today.



- **RAPID ADVANCE** . . . advance control valve opens and exhausts to cushion control valve. Cushion control valve, de-energized, directs cylinder exhaust to free outlet.
- **CUSHIONED ADVANCE** . . . advance control valve remains energized. LS-2 energizes cushion control valve, diverting cylinder exhaust to restricted outlet.
- **RAPID RETRACT** . . . retract control valve exhausts to cushion control valve, which de-energized, directs cylinder exhaust to free outlet.
- **CUSHIONED RETRACT** . . . retract control valve remains energized. LS-1 energizes cushion control valve, diverting cylinder exhaust to restricted outlet.

Write for Bulletin MAN-11. Address Bellows-Valvair, Akron 9, Ohio, Dept. TP-961.

8180

Bellows-Valvair
AKRON 9, OHIO
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

CIRCLE INFORM-A-GRAM KEY NO. 69

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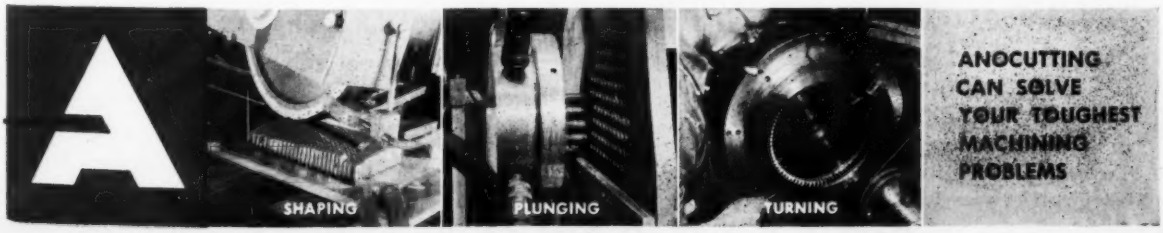

CIRCLE INFORM-A-GRAM KEY NO. 71

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ELMIRA, N.Y.

FOR TODAY'S CLOSE TOLERANCE SUPER-PRECISION SECOND OPERATION WORK

THE MODEL DSM59

- $1\frac{1}{16}$" COLLET CAPACITY
- 6" STEP CHUCK CAPACITY
- 5" JAW CHUCK CAPACITY
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The ease and simplicity of operation of the DSM59 enables relatively unskilled operators to produce parts to close limits without expensive tooling.

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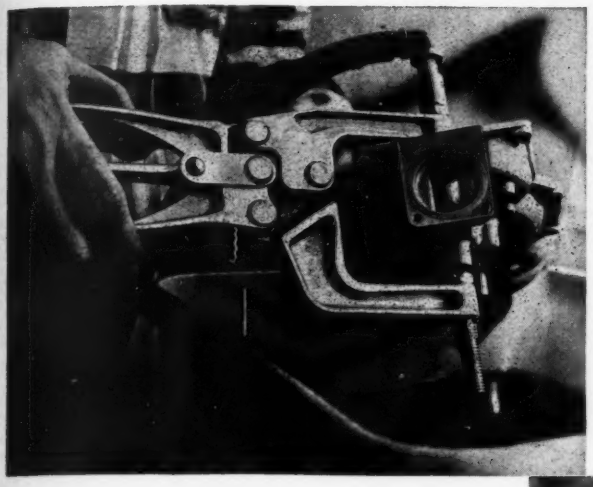
"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

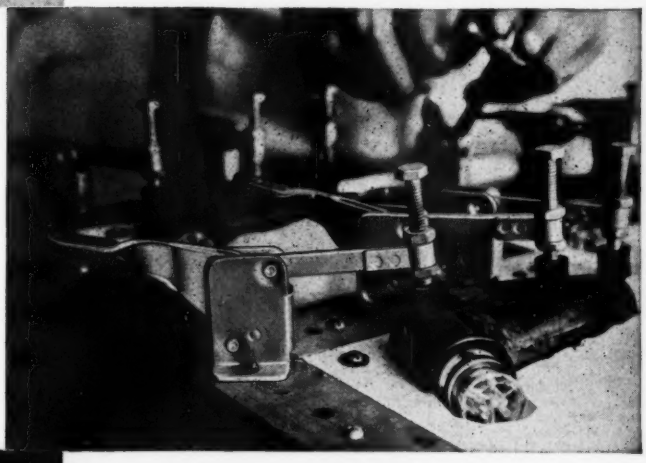
Look what clamps are doing!



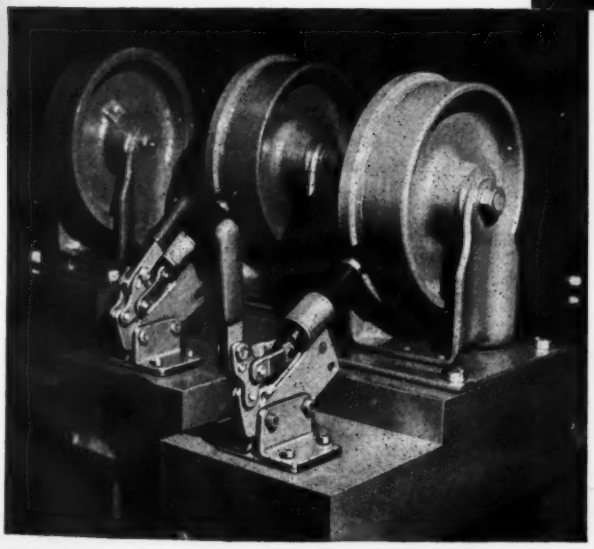
Practical uses of Wespo Toggle Clamps and Pliers that may suggest ways you can save

Toggle plier serves as low cost fixture for testing castings The air line is connected through one jaw of a Wespo Model 522 Toggle Plier. The plier is then clamped onto the casting and air applied by a foot control. Immersing the casting into a tank quickly spots any defects. Patented "Quick trigger" feature of the Model 522 instantly releases the casting; speeds testing. Rugged, lightweight Wespo toggle pliers are available in various jaw capacities and sizes.

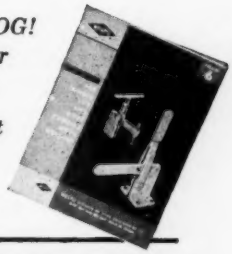
Holding these glued parts together while drying is a simple task with Wespo Horizontal Bar-Type Toggle Clamps. Neoprene-capped spindles prevent damage to plastic surfaces, yet securely hold the parts during the drying operations. Wespo toggle clamps are available in more than 80 types and sizes. So, the next time you think clamps, think Wespo!



Simple, low cost "parking brake" for this track-operated frame is provided by a Wespo Push-Pull Clamp equipped with a neoprene-capped spindle. "Brake" is quickly applied or released by a simple flick of the wrist. Wespo Push-Pull Clamps are available in various sizes and holding pressures and are ordinarily used on holding fixtures where push or pull clamping is required.



FREE CLAMP CATALOG!
Ask your Wespo distributor for your free copy of this 16-page Wespo catalog. It will help you quickly select the right clamp for every clamping job.



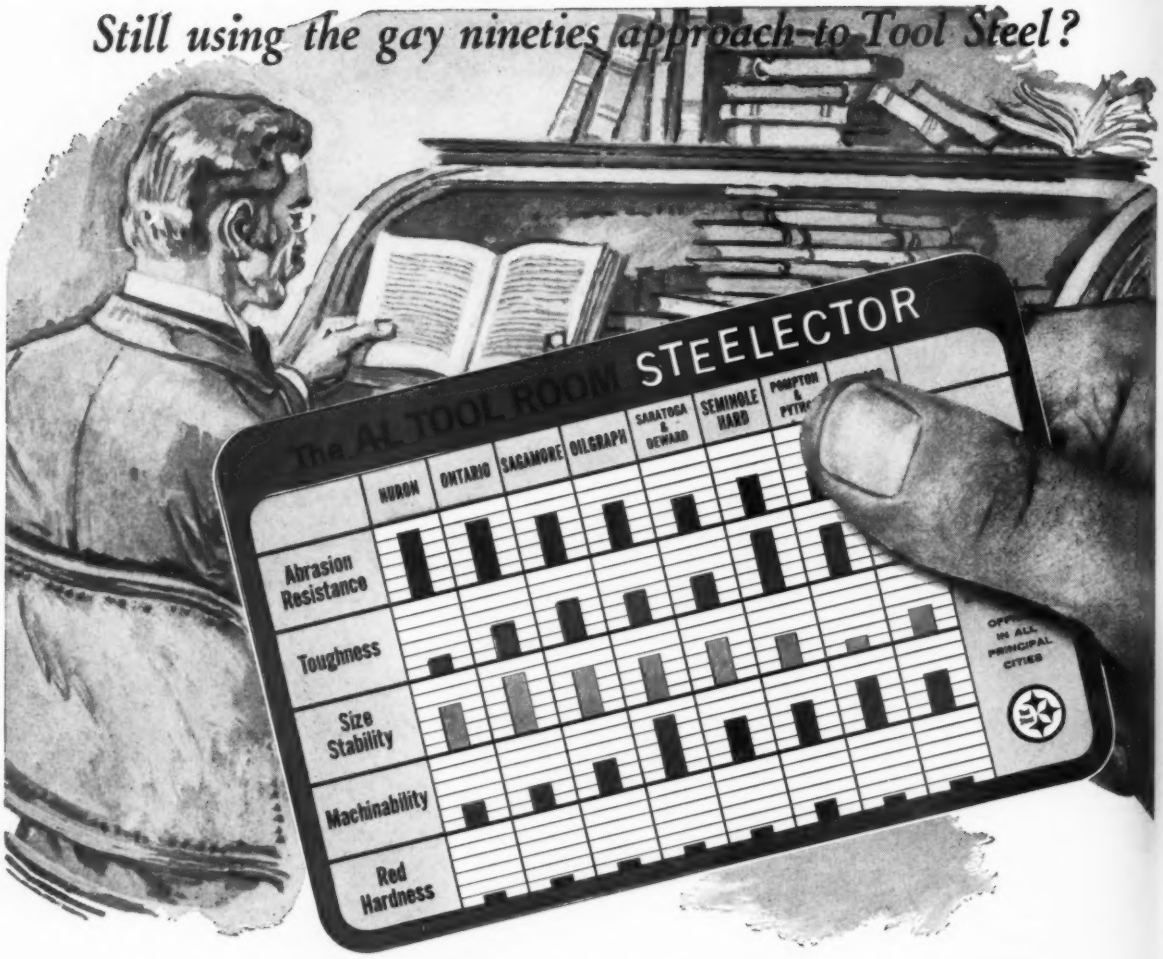
WESPO

DIVISION OF VLIER ENGINEERING CORPORATION
26935 W. Seven Mile Rd., Detroit 19, Michigan
Formerly West Point Manufacturing Company

CIRCLE INFORM-A-GRAM KEY NO. 72

CIRCLE INFORM-A-GRAM KEY NO. 73

Still using the gay nineties approach to Tool Steel?



Use the New, Modern A-L Steelector System

Now you can accurately select the proper tool steel based on its individual characteristics and be sure that it's available for off-the-shelf delivery before you place your order.

The new Allegheny Ludlum STEELECTOR Program makes tool steel selection fast. And it eliminates the embarrassment of specifying a grade which later turns out to be unavailable or available only after a costly delay.

The leading grades of tool steel that meet 96 percent of all applications—as listed in the Allegheny Ludlum Tool Steel Handbook—form the basis of the STEELECTOR Program. The STEELECTOR Grades are charted on cards covering each group of steels (tool room, hot work, and high speed grades) to help you select the particular grade best for your application.

Bar graphs on each STEELECTOR Card show how the various grades compare in abrasion resistance, toughness, size stability, machinability and red hardness. It's easy to determine accurately the combination of properties that best suits the job at hand.

The complete necessary range of sizes and shapes is listed in a special Data Stock List for every grade. These lists also include heat treating, typical working hardnesses and other data to insure that your selection is correct.

You can choose with confidence because every STEELECTOR grade has been selected from the complete line of Allegheny Ludlum Tool Steel and made under the rigid quality control standards of all A-L products.

For a complete explanation of the STEELECTOR Program, ask your Allegheny Ludlum sales representative for a copy of the colorful A-L Tool Steel STEELECTOR Booklet, or write: *Allegheny Ludlum Steel Corp., Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. TP-9.*

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

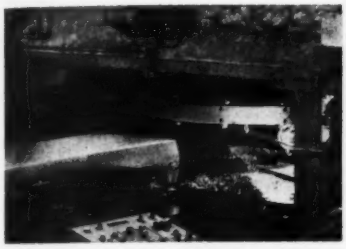
Tool Steel warehouse stocks throughout the country

CIRCLE INFORM-A-GRAM KEY NO. 74

High Costs Foiled By Throw-aways

Despite the light, bright character of aluminum foil, there's many a large, rugged machine betwixt raw ingot and pretty box. One of these, an ingot scalping miller at Anaconda's Terre Haute, Ind. works, removes blemishes from the faces of huge aluminum ingots (an ingot blemish can turn up as a mile-long tear in the foil).

The 72″ cutter had required replacement of its 12 HSS blades after every 8-hour shift. Wesson Corp., Ferndale, Mich., recommended fitting carbide parallelogram throw-aways. Since this replacement, the machine has worked more than 12 weeks between indexes of inserts.



Huge aluminum billet has been surfaced by ingot scalping machine. Wesson throw-away inserts fitted to 72″ cutter have vastly reduced cutter service time, improved surface quality.

Savings have been realized through vastly reduced cutter maintenance, and through reduction in cutter adjustment time from two hours to a few minutes.

Further advantages have been realized through better finish, although fewer blades are needed, and because the new blades can be adjusted accurately. The latter feature has permitted increasing maximum depth of cut from ⅜″ to ½″ or more, which can mean the difference between a single pass or two passes if a deep blemish is encountered.

The Inform-A-Gram Card is for your convenience in making inquiries about Advertised Products and Editorial items.

CIRCLE INFORM-A-GRAM KEY NO. 75

$1.58 per gage, in 25-gage sets under .375"0"

GAGING HOLES TO .0001", .0005", .001"?

Send for helpful FREE "GAGING SHORTCUTS" Booklet

DELTRONIC

CLASS "X" - PLUS .000,040"- MINUS .000,000" PRECISION LAPPED

APPROXIMATELY 1 MICROINCH FINISH LENGTH - 2¼", 2½", 3", 3½"

Certification of Accuracy

DELTRONIC CORPORATION unconditionally guarantees each gage herein to be within a size tolerance of plus .000,040", minus .000,00"; surface finish approximately one microinch; both ends concentric to one another. All Master Gages in our plant are calibrated semiannually or oftener, with standards traceable to the National Bureau of Standards, Washington, D. C.

Inspected by: 235

R. M. LARZELERE, PRESIDENT

RELIABILITY is assured through continuous checking and surveillance of all Deltronic production and inspection facilities by MetroLonics, an Independent Metrology Laboratory, with standards uninterruptedly and directly traceable to the National Bureau of Standards, Washington, D. C. To maintain the most exacting requirements of precision measurement, all gaging standards used in manufacturing of Deltronic gages are calibrated and certified quarterly . . . MetroLonics also completely checks samples of each and every Deltronic production run.

INSPECTION Electronic gaging equipment, accurate to ten millionths or better, is used for all measurement. Roundness is checked on a Talyrond with spindle runout guaranteed to one millionth accuracy. A polar chart showing roundness of a production-run Deltronic gage is reproduced at left. Final lapping, grinding, and inspection performed in Deltronic's plant is in temperature-controlled rooms, maintained within standard 68°, plus or minus one-tenth of 1°.

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of most-popular sizes. Over 3,000 sizes in tenths from .038" to 1"! Phone your stocking franchised distributor.

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Size etched to approx. one-tenth depth. Out-of-size when marking becomes faint - two tenths undersize when marking disappears. . . Reserve marked end for critical inspection.

HANDLE NOT NEEDED
Patented relief in center of each gage enables use without handle, whichever user prefers. Quick, easy, convenient, time-saving.

LOCAL STOCK
Your distributor stocks most-popular sizes. Also over 3,000 gage sizes in tenths, from .0375 to 1", in inventory at factory for same day shipment.

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Both ends absolutely concentric. This, plus extra length, is invaluable for layout, hole spacing measurement.

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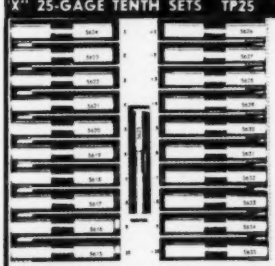
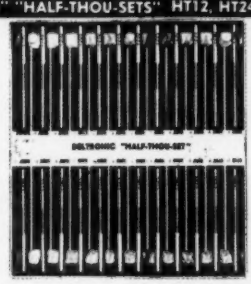
"X" 25-GAGE TENTH SETS TP25



Nominal size, + and — 12 tenth steps. Set #TP25 consists of nominal gage with 24 additional gages. Twelve gages range upward from nominal in .0001" steps each. Twelve gages range downward from nominal in .0001" steps each.

Nom. sizes .039 thru .3750	$39.40
Nom. sizes .3775 thru .6270	$43.80
Nom. sizes 41/64" thru 1"	$52.20

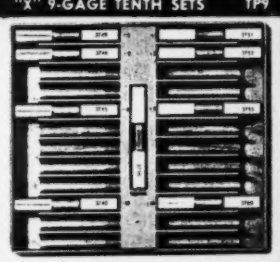
"X" "HALF-THOU-SETS" HT12, HT24



Each set consists of a nominal size gage, plus 11 or 23 gages ranging upward from nominal gage in .0005" steps

Nominal sizes	HT12	HT24
.038" thru . 2 2 8	$23.90	$39.40

"X" 9-GAGE TENTH SETS TP9

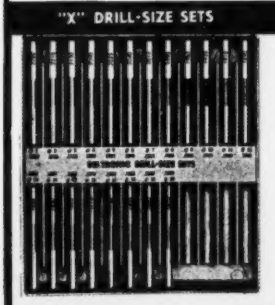


Nominal size, + and — 1, 2, 5, 10 tenths. Set #TP9 consists of nominal gage with eight additional gages. Four gages range upward from nominal .0001", .0002", .0005" .0010". Four down from nominal, .0001", .0002", .0005",.001

Nom. sizes .039 thru .3750	$19.60
Nom. sizes .3775 thru .6270	$22.40
Nom. sizes 41/64" thru 1"	$29.60

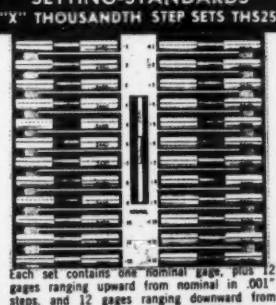
SETTING-STANDARDS

"X" DRILL-SIZE SETS



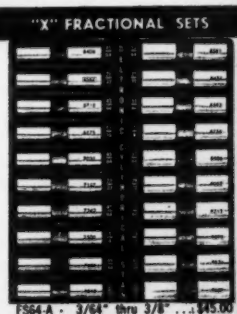
DS61-B - 21 thru 40 ..... $41.00

"X" THOUSANDTH STEP SETS THS25



Each set contains one nominal gage, plus 12 gages ranging upward from nominal in .001" steps, and 12 gages ranging downward from nominal in steps of .001", total of 25 gages

"X" FRACTIONAL SETS



FS64-A - 3/64" thru 3/8"	$45.00
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and Handle

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die sets *faster*, safer, more efficiently!

Because SUPERIOR offers Exclusive Safety Features such as Special Gripping Flanges for finger protection; . . . Lock Jaw Lifting Device attaches to flange quickly and easily . . . and E-Z Lift Sling Chain . . . all provide fast, safe handling of large and small die sets.

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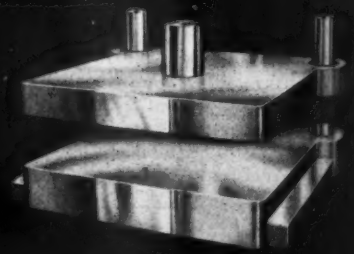

THE *Exclusive* SET

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Know-How Needed In Adjusting Ring Gages

FROM Frank J. Vlasaty of Size Control Co. (Divn. of American Gage & Machine Co.) come three cautions in adjusting ring gages for checking external screw threads. Ignoring these, says Vlasaty, is all too common, and can cost dearly in gage life and in needless product rejection.

1) Adjust your ring gage in the right sequence of steps: (a) loosen locking screw, (b) put gage on full-thread portion of set plug, (c) *open or close ring by means of the adjusting screw (split member threaded both inside and out)*, (d) tighten the locking screw. Remember that the locking screw's only

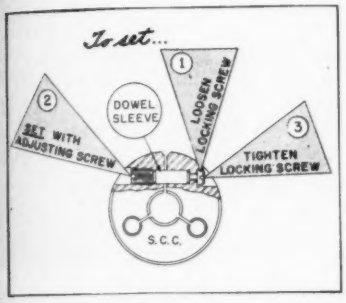


Figure 1

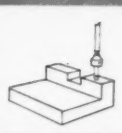
function is to lock (not to adjust). It's helpful to hold the shank or handle of the set plug in a vise and use two screwdrivers, one in each hand.

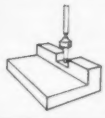
2) Be sure your ring gage will not accept the setting plug when the adjusting assembly is loose (and the ring collapses). The adjusting screw is designed to spread the gage by exerting force through the precision dowel sleeve (*not* to close the gage by tension in the locking screw). If a gage fails this test, it is worn or sprung, and should be replaced.

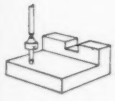
3) Use gages in which the dowel sleeve is selectively fitted (within one tenth) into its reamed bore. Although U.S. Commercial Standard CS8-51 limits both ream tolerance (3 to 5 tenths depending on size) and dowel sleeve tolerance (2 to 3 tenths), mismatched assembly can give sloppy fits which can cause a planar distortion like that of a split-type lock washer. Check the sleeve fit by removing

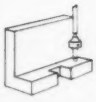
. . . Continued on page 78

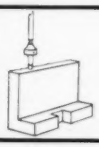
6
DIFFERENT MEASUREMENTS ON THIS PART IN LESS THAN A MINUTE!


PIECE HEIGHT


GROOVE HEIGHT


BOTTOM THICKNESS


BACK THICKNESS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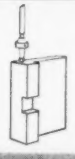
LENGTH

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BAUSCH & LOMB INCORPORATED
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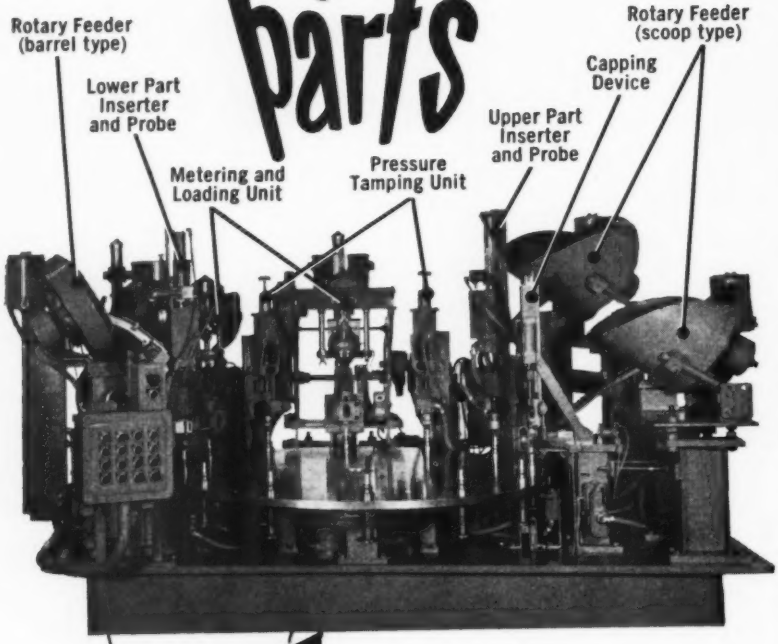
CIRCLE INFORM-A-GRAM KEY NO. 77

CIRCLE INFORM-A-GRAM KEY NO. 76

in go the parts



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CIRCLE INFORM-A-GRAM KEY NO. 78

. . . Know-How, from page 77

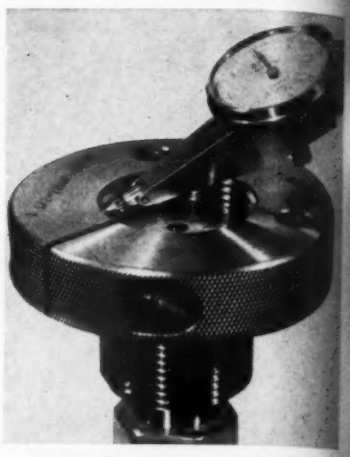

Fig. 2—To help ensure correct assembly and adjustment, gage distortion is checked by dial indicator.

adjusting screw and locking screw, determining if the sleeve will fall out under a gentle shake. If so, it's too loose. Test against lockwasher effect by the use of an indicating gage on the thread flanks across the locking slot (Fig. 2).

Value Engineering Book Discussed

VALUE ENGINEERING, VOLUME 2, edited by Richard S. Mandelkorn. Published by Engineering Publishers, Division of AC Book Co., Inc., P.O. Box 2, Elizabeth, N.J., 1961, 167 pages, $7.50.

This second volume, a companion to one published in 1959, is based on the Second Electronic Industries Assn. conference on Value Engineering held at Anaheim, Calif. Twenty-four specialists in the field have contributed, and the work of each has been given a chapter.

Information is aimed at explaining how the principles of modern value engineering are used to reduce the cost of manufactured products while maintaining or improving product quality. Procedures to obtain the confidence and active cooperation of others, to analyze the function rather than the product itself, to equate value with cost, and to devise new designs to bring cost into balance with value to the customer are all discussed in detail.

Closeup of the massive automatic feed drive for the Clearing production system above.

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A Complete Production System Erected and Proved *Before Delivery*

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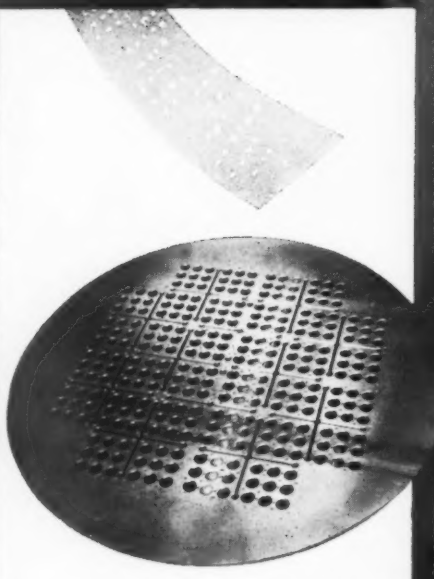
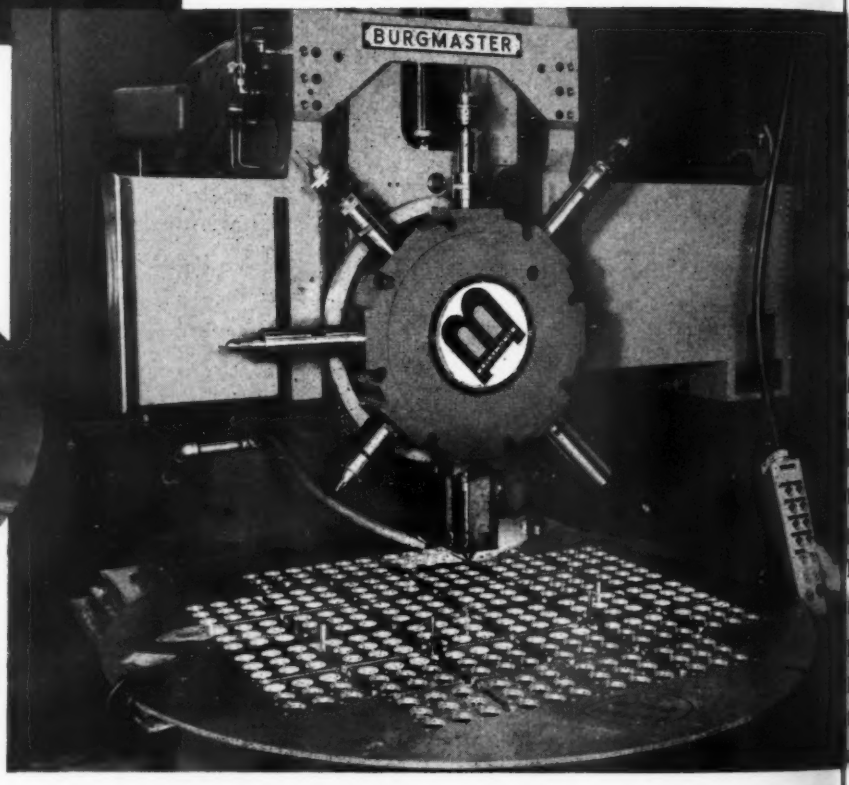
CIRCLE INFORM-A-GRAM KEY NO. 79

GENERAL ELECTRIC USES ...master

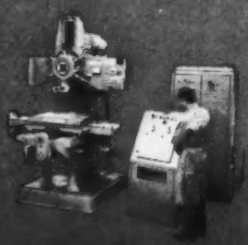
- **Production Speeded from 8 Weeks to 9 Days**
- **Saves 60 Hours of Lead Time**
- **$800.00 Fixture Eliminated**



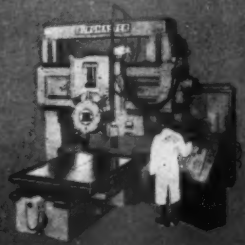


Burgmaster
Model 3BHT
8-spindle, 1½" capacity in steel. Table travel 20x30, 30x45.

Model 2BHT
6-spindle, ¼" capacity in steel. Table travel 10x18, 15x26, 20x30.



Model 25AHT
6-spindle, 1¼" capacity in steel. Table travel 15x26, 20x30, 30x45.



Model 3...
Double Ho...
Planer Type
8-spindle,
1½" capa...
steel. Table ...
48x60.

CONTROLLED TURRET DRILLS

TO PROGRAM 2,098 OPERATIONS EACH PART

(General Electric Company, Atomic Power Equipment Dept., San Jose, Calif.)

Tape-Controlled milling operations are now added to the versatility of the Burgmaster Model 3BHT, 8-spindle tape-controlled Turret Drills. At General Electric's San Jose facility, 10 slots .176" wide and 3½" long, and 24 slots ⅜" wide and 10" long are milled in a 6061-TC aluminum nuclear reactor grid plate ⅜" thick. These milling cuts are rough and finish, both sides, and are all programmed in tape. 1962 additional center drill, drill, bore, ream and tap operations necessary to complete each unit are also programmed in tape and performed by the Burgmaster Model 3BHT with push-button control. All holes are held to .004" true position over entire area. In this operation, production has been speeded from 8 weeks to 9 days, 60 hours of lead time have been saved and an $800.00 fixture eliminated.

JOB FACTS

Company: General Electric, Atomic Power Equipment Department, San Jose, California.

Machine: Burgmaster Model 3BHT—"GENERAL ELECTRIC MARK II" Tape-Controlled Turret Milling, Drilling, Tapping and Boring Machine.

Part: Nuclear Reactor Grid Plate, ⅜" x 55½" diameter.

Special Attachments: Milling, Reciprocating Drilling, 3-Dimensional.

Lot Size: 2

Tolerance: .004" of True Position Over Entire Area.

Holding: 2 Pins on Sub Plate, Simple Clamps.

Machine Operations: Total 2,098 Machine Operations.
288 holes—center drill, drill, bore and ream (4)
384 holes—drill (1)
128 holes—drill and tap (2)
60 holes—drill and bore (2)
50 holes—drill (1)
10 slots—mill, rough and finish both sides (4)
24 slots—mill, rough and finish both sides (4)

Former Method: Individual Milling and Drilling Machines with Drill Fixtures.

Present Method: All operations programmed in tape for Burgmaster Model 3BHT.

Savings: 31 Days, 60 hours lead time, $800.00 fixture.

Other Advantages: Greater Accuracy, Less Cost. No Scrap Loss, Eliminates Operator Fatigue.

Send for Literature

Write for bulletin describing Burgmaster 6 and 8 Spindle Tape Controlled Turret Drilling, Tapping and Boring Machines. Forty minute 16 mm sound film showing all Burgmaster Turret Drills in operation is available without charge from any office.

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World's Largest Builder of Turret Drilling Machines

"0" Manual Power Index ¼" Capacity

1C Manual Power Index ⅜" Capacity

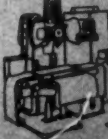
2B Manual Power Index ¾" Capacity

2BR Ram Type Radial Drill ¾" Capacity

2BH Automatic Hydraulic ¾" Capacity

3BH Automatic Hydraulic 1½" Capacity

25AH Automatic Tape Controlled 1¼" Capacity

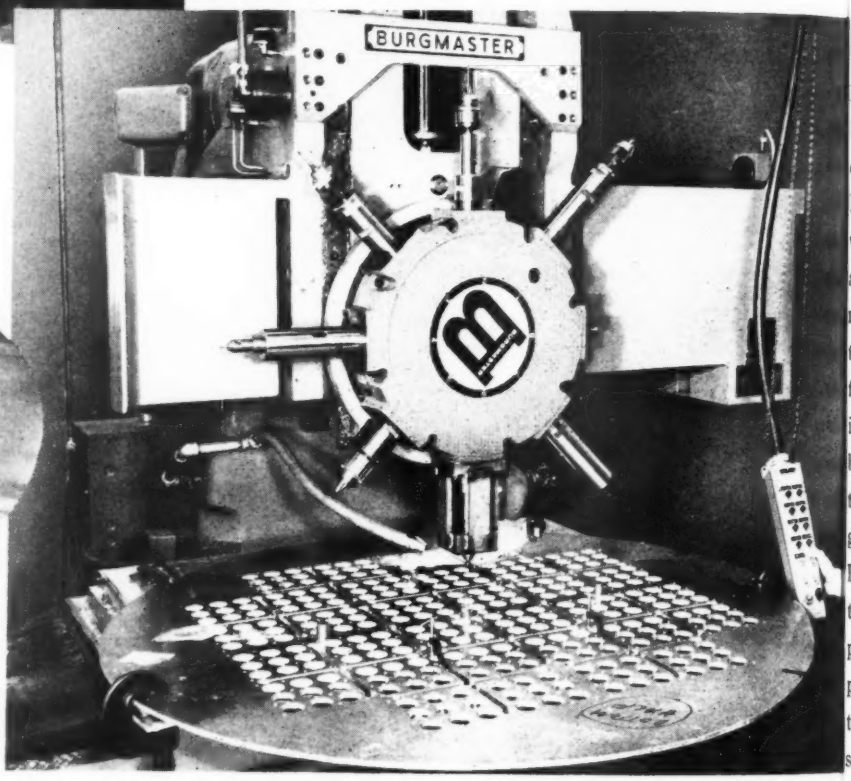

2BHT-3BHT Automatic

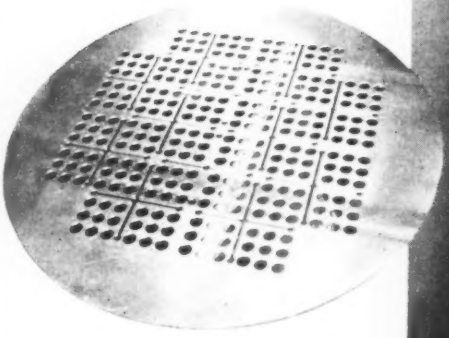
GENERAL ELECTRIC USES

Burgmaster

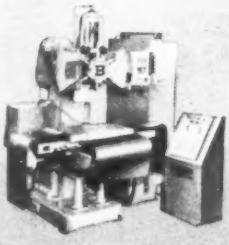
TAP

- **Production Speeded from 8 Weeks to 9 Days**
- **Saves 60 Hours of Lead Time**
- **$800.00 Fixture Eliminated**

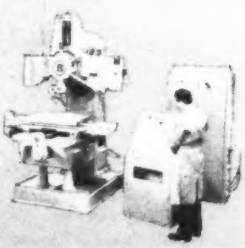




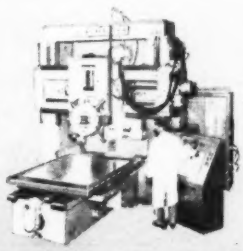
Burgmaster
Model 3BHT
8-spindle, 1½" capacity in steel
Table travel 20 x 30, 30 x 45.



Model 2BHT
6 spindle, ¾" capacity in steel. Table travel 10 x 18, 15 x 26, 20 x 30.



Model 25AHT
6-spindle, 1¼" capacity in steel. Table travel 15 x 26, 20 x 30, 30 x 45.



Model 3BHT-
Double Housi
Planer Type
8-spindle, 1½" capacity
steel. Table tr
48 x 60.

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. . CONTROLLED TURRET DRILLS

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(General Electric Company, Atomic Power Equipment Dept., San Jose, Calif.)

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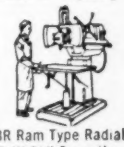
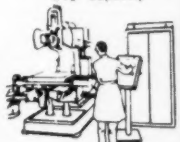
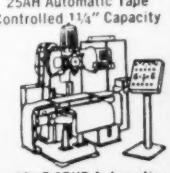

2BR Ram Type Radial Drill ¾" Capacity

2BH Automatic Hydraulic ¾" Capacity

3BH Automatic Hydraulic 1½" Capacity


25AH Automatic Tape Controlled 1¼" Capacity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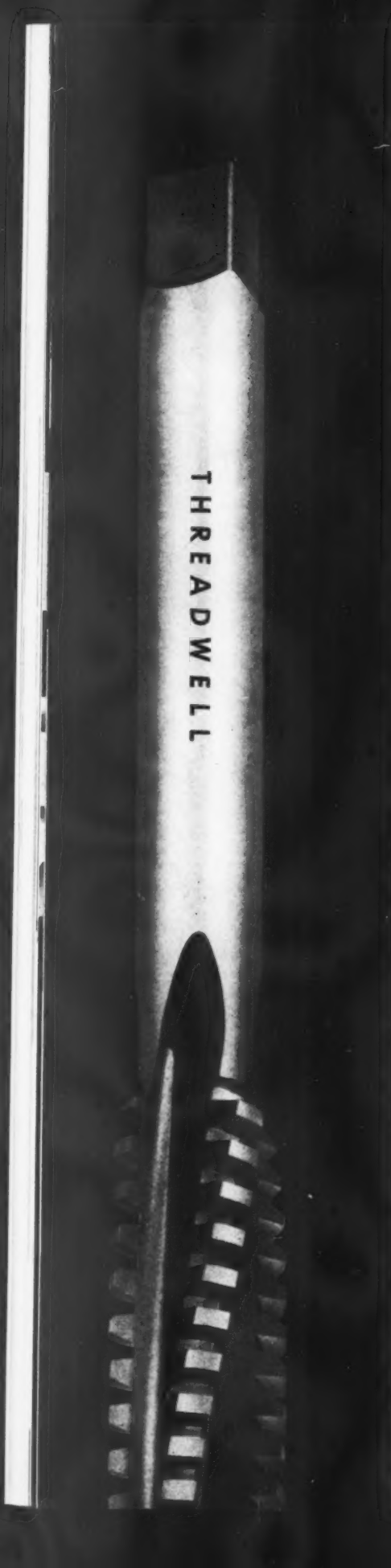

PLAIN FACTS

on

ACME TAPS

from THREADWELL

...pioneer in special purpose taps

Acme Taps are nothing new with Threadwell. We have made them successfully for years. Recently, however, we have had an influx of inquiries on the subject. This prompts us to give warning to potential users of Acme Taps:

THERE IS NO GENERAL PURPOSE ACME TAP The very nature of the thread is not conducive to free cutting. The thread is coarser; the 29° form is hard to relieve; chips caused by deep, coarse threads block lubrication; lead screws are often needed to control tap travel.

HOWEVER Threadwell Engineers in many cases have designed single pass Acme Taps with outstanding success, replacing sets of two, three and more. We insist, however, that each Acme Tap must be designed for a specific application.

SUGGESTION If you are considering Acme Taps, go over your prints with your Threadwell Distributor or Representative. You'll save time and money, because Threadwell will not make an "under-designed" tap or sell you more tap than you need.

THREADWELL TAP & DIE CO.
GREENFIELD, MASSACHUSETTS

an affiliate of THE Bendix CORPORATION

CIRCLE INFORM-A-GRAM KEY NO. 82

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for SEPTEMBER 1961

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ADVERTISEMENTS

2	15	29	67	82	95	982	1051	1092	1121	1152	1201	1242
3	16	30	68	83	119	983	1052	1093	1122	1153	1202	1251
4	17	31	69	84	127	984	1053	1094	1123	1161	1211	1252
5	18	33	71	85	129	991	1054	1101	1124	1162	1212	1253
6	19	34	72	86	131	992	1061	1102	1131	1163	1213	1261
7	20	35	73	87	500	1011	1062	1103	1132	1164	1221	1281
8	21	36	74	88	661	1012	1063	1104	1133	1171	1222	
9	22	38	75	89	662	1013	1071	1111	1134	1172	1223	
10	23	61	76	90	663	1014	1072	1112	1141	1173	1224	
11	25	62	77	91	971	1031	1081	1113	1142	1181	1231	
12	26	63	78	92	972	1032	1082	1114	1143	1182	1232	
13	27	64	79	93	973	1033	1083	1115	1144	1183	1233	
14	28	65	81	94	981	1034	1091	1116	1151	1184	1241	

EDITORIAL ITEMS

C1	C8	C15	C22	C29	C36	C43	P2	P9	P16	P23	P30	P37
C2	C9	C16	C23	C30	C37	C44	P3	P10	P17	P24	P31	
C3	C10	C17	C24	C31	C38	D1	P4	P11	P18	P25	P32	
C4	C11	C18	C25	C32	C39	D2	P5	P12	P19	P26	P33	
C5	C12	C19	C26	C33	C40	D3	P6	P13	P20	P27	P34	
C6	C13	C20	C27	C34	C41	D4	P7	P14	P21	P28	P35	
C7	C14	C21	C28	C35	C42	P1	P8	P15	P22	P29	P36	

Which article in this issue interested you most? _____

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EDITORIAL ITEMS

C1	C8	C15	C22	C29	C36	C43	P2	P9	P16	P23	P30	P37
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C3	C10	C17	C24	C31	C38	D1	P4	P11	P18	P25	P32	
C4	C11	C18	C25	C32	C39	D2	P5	P12	P19	P26	P33	
C5	C12	C19	C26	C33	C40	D3	P6	P13	P20	P27	P34	
C6	C13	C20	C27	C34	C41	D4	P7	P14	P21	P28	P35	
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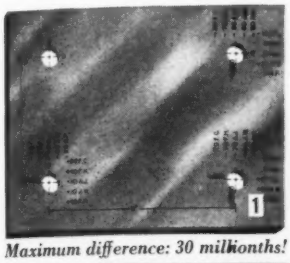
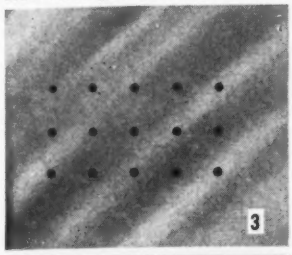
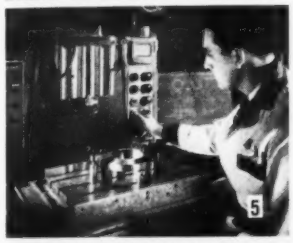
Before you buy your next JIG BORER insist on these 10 VITAL MUSTS



Maximum difference: 30 millionths!





The "musts" listed on this page are among the features of the new No. 3 Moore Jig Borer, which locates and bores holes to less than a "tenth". We will gladly send you an illustrated brochure, upon request.

Moore Special Tool Company, Inc.
726 Union Avenue
Bridgeport 7, Connecticut

1...*must have linear and geometric accuracy*
The 4 holes shown were bored on the No. 3 Moore Jig Borer. They were then ground on the No. 3 Moore Jig Grinder. This illustrates the exactness of location of Moore's master lead screws. The locations were measured by 5 men on the Moore Universal Measuring Machine (initials). All geometry tolerances are held to much less than .0001". Dependability of positioning, once set, is assured by our non-influencing table and saddle clamps...no more than .000010" movement from clamping.

2...*must be built for long life*
Hardened ground and lapped wear parts:
(1) Quill support bushings
(2) Nitralloy Quill
(3) Hardened Spindle
(4) Hardened V-Ways and Flat-Ways
(5) Nitralloy Lead Screws

3...*must offer fast settings*
15 Holes in 7½ Minutes—This job demonstrates the rapidity and accuracy of Moore's method of lead screw settings ...as well as our quick tool change and ability to duplicate hole size. Holes in this plate have been spotted and drilled in one operation and bored to a "tenth" in the second operation. Consequently, the operator must move the table to hole location 30 times. One tool change; job complete in 7½ minutes, or 30 seconds per hole.

4...*must provide fast tool change*
The Moore Shank, if removed and replaced, will repeat hole size on any diameter. This Shank is recognized as the fastest, most accurate system of changing tools in a jig borer. Toolroom application, with variety of hole sizes, requires constant tool-changing. Quick tool-changing is also a "must" on production jobs.

5...*must have fast spindle speed changes*
Just as you operate the accelerator of your car to increase or decrease speed, so here by a push of the button on the control panel you get exactly the speed you want...and can read it easily on the tachometer. There are no auxiliary back gears, switches or levers to be concerned about.

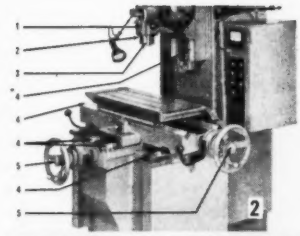
6...*must be rugged for heavy cuts*
This photo shows hole hog in use, increasing 1½" hole to 2½" in a single cut. Six additional cuts of approximately ⅜" each will increase this 2½" hole to 5".

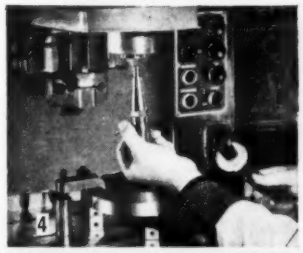
7...*must be sensitive for small holes*
Standard .013" drill held in ⅛" capacity chuck. Drill held short, no spotter used.

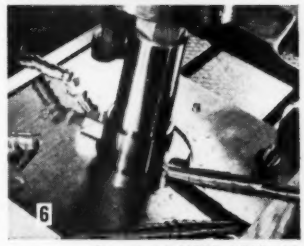
8...*must be simple to operate*
The position of the table is accomplished by two master lead screws .100" per turn, .001" per line, .0001" reads on the vernier. The scale counts the turns, being graduated in 10 lines per inch. Repeat settings can easily be made with the naked eye to ten millionths (.000010").

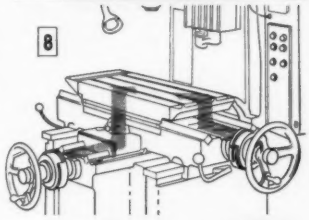
9...*must have full line of cutting tools*

10...*must have full line of hole-location accessories*
There is no job that cannot be done efficiently with our standard stock of cutting tools and accessories.

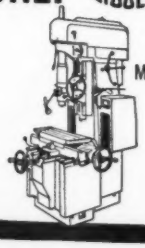




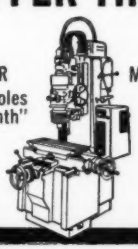




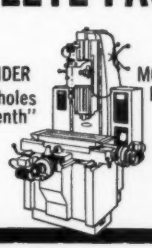
ONLY MOORE TOOLS CAN OFFER THIS COMPLETE PACKAGE OF PRECISION



MOORE No. 3 JIG BORER
Locates and bores holes to less than a "tenth"



MOORE No. 3 JIG GRINDER
Locates and grinds holes to less than a "tenth"



MOORE UNIVERSAL MEASURING MACHINE
Measures to one-third of a "tenth"

MOORE ROTARY TABLE
Divides the circle to less than 2 sec.

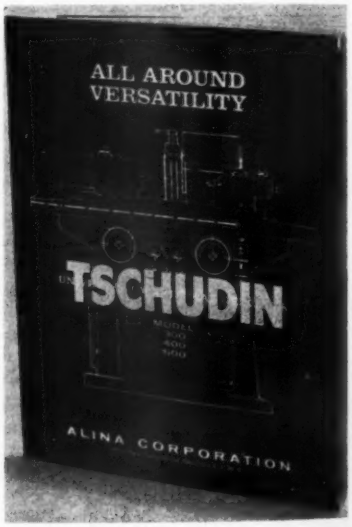
T&P Catalogs & Literature

Carbide tipped tools, blanks, inserts and holders are featured in a 36-page catalog from Besly-Welles Corp. Besly-Welles, manufacturer of grinders, cutting tools and gages, used Kennametal material. Inform-A-Gram No. C1.

Soft chuck jaw blades, alloy studs, nuts and washers, drilling, milling and jig vises, coolant pumping systems and filtered cleaning systems are presented in a folder from the Morton Tool Co. Inform-A-Gram No. C2.

Tantung, a superior cast alloy for tool cutters and wear applications, is outlined in a booklet from Vascaloy-Ramet. Section cover how to braze and grind Tantung and how to use it combined with carbide and HSS. Inform-A-Gram No. C3.

Crown Tool, Inc. offers a convenient chart to convert time into pcs/hr. The chart gives cycle time from 0.6 to 60 sec, and from 0.01 to 1.00 min, then converts into pcs/hr at 100% efficiency. Pcs/hr figures range from 6000 to 60. Inform-A-Gram No. C4.

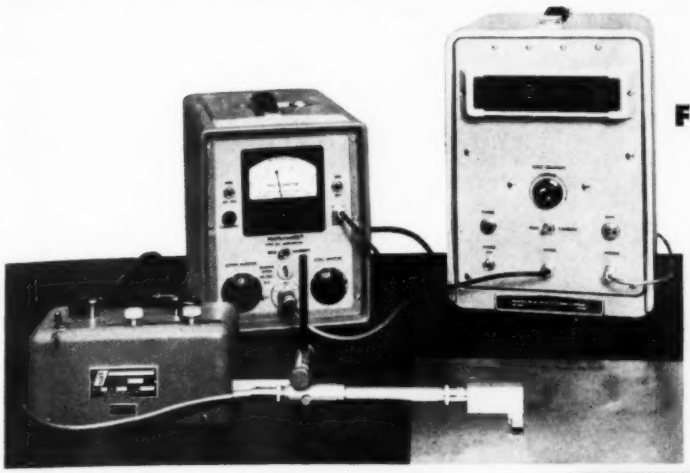


Tschudin universal grinders, and any desired technical information pertaining to them, are featured in a 20-page catalog from Alina Corp. Inform-A-Gram No. C5.

Marking Inform-A-Gram No. C6 will bring you "Flat Finishers Catalog FF-755" from Hammond Machinery Builders, Inc.

QUOTING...
THE
TIMKEN
ROLLER BEARING
COMPANY
ON Hammond
ELECTROLYTIC
TOOL GRINDERS
"We are happy to report that our two SCE-10 Hammond Automatic Oscillating 10" Duplex Electrolytic Grinders are producing substantial savings due to the reduction in tool resharpening time and diamond wheel costs.
For example, we are removing .045" of solid carbide in 45 seconds from a tool approximately 1 2" square, processing two tools simultaneously. We are realizing a savings of 7 to 1 in diamond wheel costs, and a reduction in grinding time of approximately 4 to 1."
DIAMOND WHEEL
COST REDUCED
7 to 1
GRINDING TIME
REDUCED
4 to 1
. . . Another dollars and cents success story for Hammond Electrolytic Grinders! If you, too, are after IMPORTANT savings in carbide tool grinding, take this simple step now: Send us a few single point tools to be ground. They'll be returned promptly with a "processing and time required report." No obligation.
Hammond OF KALAMAZOO
Hammond Machinery Builders
1631 Douglas Avenue, Kalamazoo, Mich.
CIRCLE INFORM-A-GRAM KEY NO. 84

BREAKING MEASUREMENT BARRIERS WITH MICROMETRICAL



COUNTS ROUGHNESS PEAKS FOR CLOSER SURFACE CONTROL

The Profilometer® with Peak Counter adds a new dimension to control of surface finish. This new combination shows the number of roughness peaks above a preselected height, in addition to showing average roughness height in microinches. We developed it to help solve surface-finish problems for sheet steel makers and users; and it has many other potential uses—perhaps in YOUR plant. Ask for BULLETIN LT143 and see.

MEASURES SURFACE WAVES TO AID PRODUCT PERFORMANCE

With many products, performance depends on the waviness around surfaces of rotation. The Wavometer® measures such waviness, in microinches, on a production basis. Example: In meeting a Navy quiet bearing contract, a ball bearing manufacturer checks the waviness around every raceway, as shown at right.

For waviness facts and Wavometer features, ask for BULLETIN LT10.

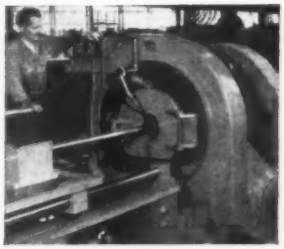
SHOWS FULL DETAILS OF ALL SURFACE IRREGULARITIES

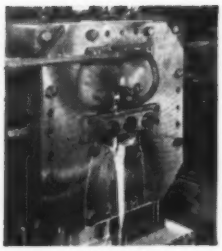
In research or inspection, would it help you to know the height and length of surface waves, bows, or roughness irregularities? Dimensions and location of flaws or wear? Straightness, roundness or concentricity of ID's and OD's? Alert manufacturers in many industries meet ALL such needs with the Proficorder®—get pen-drawn magnified profiles that show exactly what they need to know. Interested? BULLETIN LT24 tells all about it.

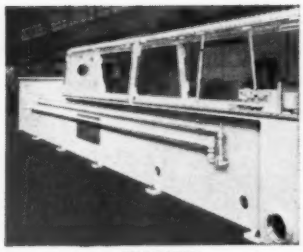
MMC®
MICROMETRICAL
MANUFACTURING COMPANY
A SUBSIDIARY OF THE BENDIX CORPORATION
3621 S. STATE RD. ANN ARBOR 6, MICHIGAN

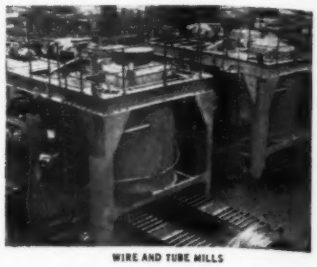
Manufacturer of the PROFILOMETER® • PROFICORDER® • MICROCORDER®
WAVOMETER® • ANDEROMETER® • VAROMETER®

CIRCLE INFORM-A-GRAM KEY NO. 85

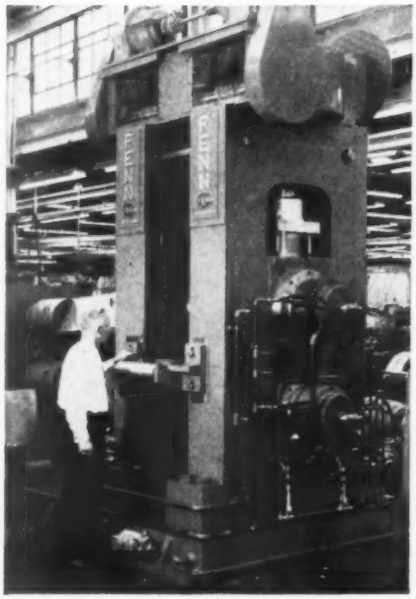

SWAGING MACHINES


TURKS HEADS

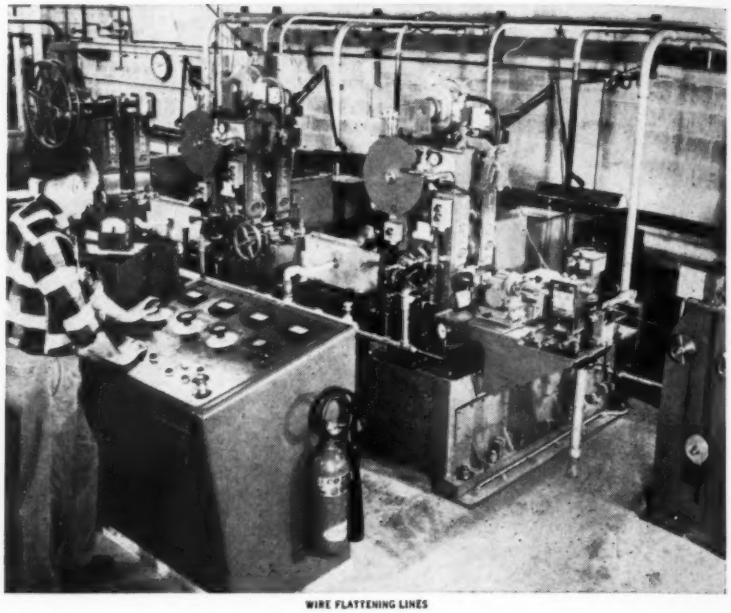

DRAW BENCHES


WIRE AND TUBE MILLS

PRECISION • PERFORMANCE • DEPENDABILITY



ROLLING MILLS


WIRE FLATTENING LINES

METAL FORMING MACHINES

that meet the challenges of the 60's

Within a relatively short span of years the name FENN has become well-known to users of metal forming equipment. In rolling mills . . . wire mills . . . in the nuclear industry . . . and wherever else ferrous or nonferrous metals are rolled, drawn, or formed to precision tolerances, Fenn machines are producing profits for their users. The extensive Fenn line is built on long experience in the manufacture of *precision* machinery and an equally long reputation for *performance* and *dependability*. Behind every Fenn machine is unexcelled engineering . . . from design to inplant checkout and continuing field service, plus an organization that strives to do every job better than the expected. Whatever your metal forming machinery requirements, you can depend upon your nearest Fenn representative for his experienced advice and practical help. Comprehensive literature will be promptly sent upon request. The Fenn Manufacturing Company, Fenn Road, Newington, Connecticut.

Designed and Built by FENN

CIRCLE INFORM-A-GRAM KEY NO. 86

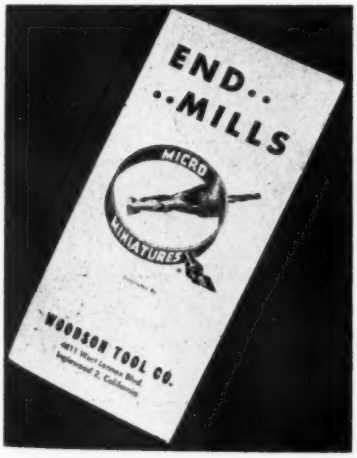
Catalogs . . .

Air valves that fill and exhaust a 100 cu in. load chamber from 0 to 90 psi (100 psi pressure) in 0.150 sec, are extolled in Bulletin 0611-B1 from Hannifin Co. Inform-A-Gram No. C7.

Circling Inform-A-Gram No. C8 will bring you Catalog BN (first edition.) It covers the Wales-Strippit, Inc. self-contained tooling line.

Landis Tool Co.'s 6 x 18" precision hand feed surface grinder is described in a new eight-page catalog. Inform-A-Gram No. C9.

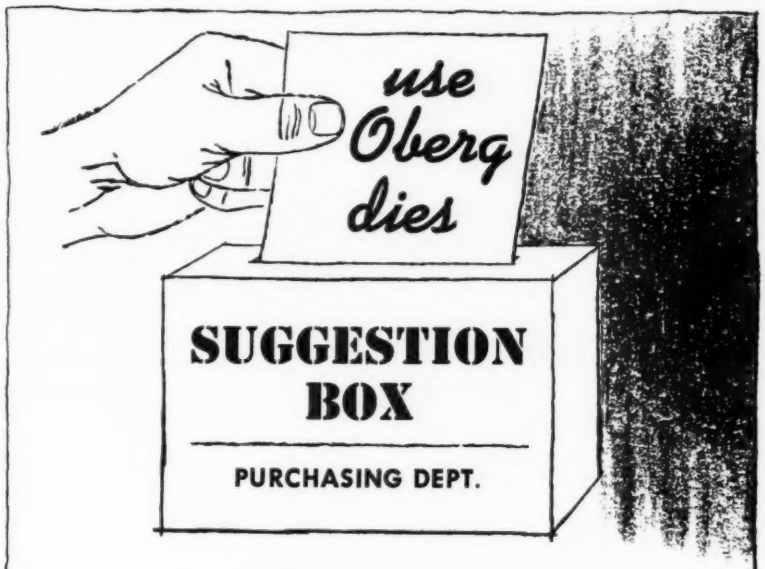
Producto Model VT-1 Universal hand tapping machine is presented in a brochure from The Producto Machine Co. Check Inform-A-Gram No. C10.



Micro-Miniature end mills and router bits are covered in a 24-pager from Woodson Tool Co. Inform-A-Gram No. C11.

Precision boring machines, both horizontal and vertical models, hydraulic and cam operated, are the subject of a new booklet from Ex-Cell-O Corp. Inform-A-Gram No. C12.

A convenient calculator determines slitter knife clearances. The double plastic wheel can be set to material thickness. A window shows the recommended horizontal and vertical clearances. Heppenstall Co., Inform-A-Gram No. C13.



Employees receive thousands of dollars annually from companies for money-saving ideas. But here's a switch! At Oberg, it is the customer who receives money-saving ideas—ideas that are designed, engineered and built into every Oberg Carbide Die by skilled personnel, equipped with experience and modern machines. These Oberg ideas pay off over the full life of the die! And you'll get some mighty fine ideas yourself when it comes to Oberg service. Because . . .

Oberg is something special

Oberg Manufacturing Co., INC.

FREEPORT, PA.

Send today for NEW brochure, Bulletin 261, describing Oberg dies, service and facilities.

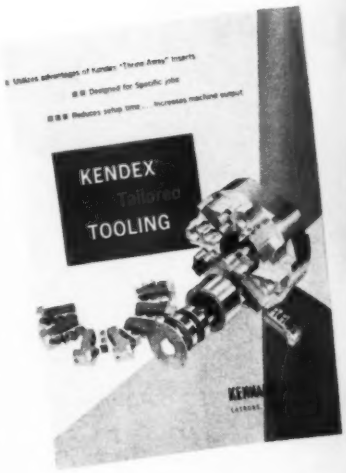
CIRCLE INFORM-A-GRAM KEY NO. 87

Catalogs . . .

Precision location of round shaped holes can be accomplished by any press operator to an accuracy of 0.001. The answer is Wales-Strippit Inc.'s quick change holder with micro set gaging system usable on any 15A, 10AA and 10A Strippit fabricator. The story is told in a brochure from the company. Inform-A-Gram No. C14.

Circling Inform-A-Gram No. C15 will bring you Bulletin 4609.1 from Lincoln Electric Co. Subject is Idealarc R3M 3-phase rectifier type DC arc welder that handles any type manual arc welding electrode.

Three types of precision adjusting tools that adjust in tenths without loosening or tightening screws are illustrated in a catalog from Briney Mfg. Co. Inform-A-Gram No. C16.



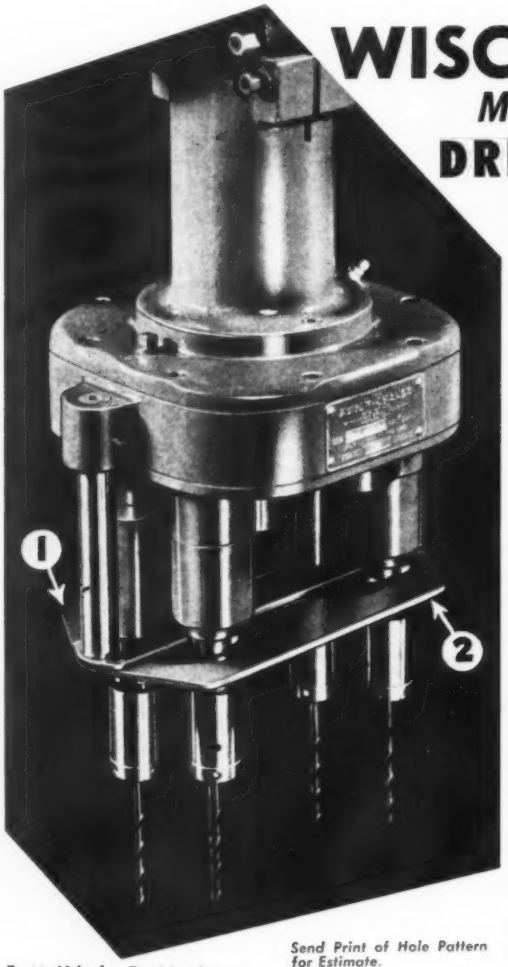
"Kendex Tailored Tooling" is the title of Bulletin B-600 from Kennametal, Inc. Featured is the use of Kendex standardized adjustable units with throw-away inserts in multiple-insert and special tools. Inform-A-Gram No. C17.

Davis tap-leader for drilling and tapping permits power feed for tapping on horizontal or vertical spindle machines not equipped with thread leads or non-matching leads. Giddings & Lewis Machine Tool Co. offers Bulletin D-180. Inform-A-Gram No. C18.

Brush 190, a mill heat-treated beryllium copper strip by The Brush Beryllium Co. is described in a data sheet. Available on Inform-A-Gram No. C19.

Bulletin 10C tells of the S-P Mfg. Corp.'s new series A2 pneumatic and hydraulic cylinder line. Check Inform-A-Gram No. C20.

CIRCLE INFORM-A-GRAM KEY NO. 89



Send Print of Hole Pattern for Estimate.

WISCONSIN
Multiple
DRILL HEADS

Adjustable and Fixed-Spindle Types

Adjustable Spindle Heads have Dual Positioning Plates for fast, accurate set-ups that "stay put".

Positioning and Locking Templates are furnished for each bolt circle or hole pattern . . . to your exact specifications.

Half-hole Positioning Plates (1) make it easy to swing spindles into place quickly. Locking Plates (2), with full holes, are mounted on support posts to lock set-ups securely against shifting.

6 Capacity Ranges . . . from "Light Duty" to "Extra Heavy Duty". Standard Models have 2 to 8 spindles. Special Models built to order.

1. Half-hole Positioning Plate.

2. Locking Plate has full holes to hold spindles in place.

Wisconsin builds Standard Adjustable-Center Drill Heads, Special Fixed-Center Drill Heads, Lead Screw Tapping Units, Wis-Matic Universal Drill Tap Machines, Fixture Bases, and Special Drilling and Tapping Machines.

WISCONSIN DRILL HEAD CO.

4975 N. 124TH STREET • BUTLER, WISCONSIN

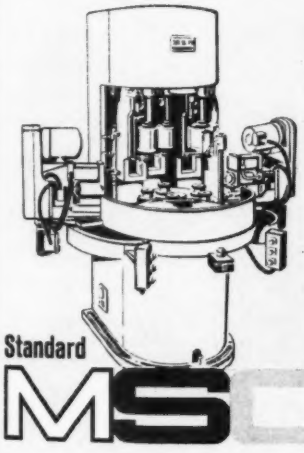
CIRCLE INFORM-A-GRAM KEY NO. 88

for an hours run or day-in day-out production...

IMPORTANT COST REDUCTIONS WITH Standard MSO

900 PER HOUR
1200 PER HOUR
ELECTRONIC CONNECTOR
Operations Performed: Center drill to C'Sink, drill .0436/.0466 hole, cross mill slot, deburr hole and O.D. Material: Beryllium Copper. Time: 3 seconds—1200 per hour.
PULLEY
Operations Performed: Tap Drill cross hole, C'Sink Flange (cut off end) Tap .8-32, Burr Ream I.D. Material: Alu-minum. Time: 4 seconds—900 per hour.
600 PER HOUR
CAM SHAFT
900 PER HOUR
SPECIAL STUD

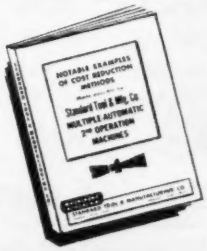
All 2nd operation machining of each of these parts performed simultaneously by a Standard MSO.



Standard MSO

A high speed, versatile machine which performs many multiple, second operations — simultaneously — with great accuracy. Complete details regarding mechanical features and specifications contained in a new booklet available on request. Ask for Booklet, No. 61.

Small Shop or Large Plant cannot afford to be without Standard MSO. The applications are endless—the technique unmatched. For Standard MSO performs up to 5 simultaneous operations at high speed with extreme accuracy—eliminates the need for Hand Screw Machines, Drill Presses, Light Milling Machines, Tapping and Threading Machines and other single purpose machines. Tooling and change-over is quick and simple.



This Illustrated Booklet, No. 35, can help you gain important cost reductions. It contains many detailed, case history drawings. We shall be glad to send you a copy without charge.

MACHINERY DIVISION

Standard Tool & Manufacturing Co.

717 SCHUYLER AVENUE • LYNDHURST, NEW JERSEY

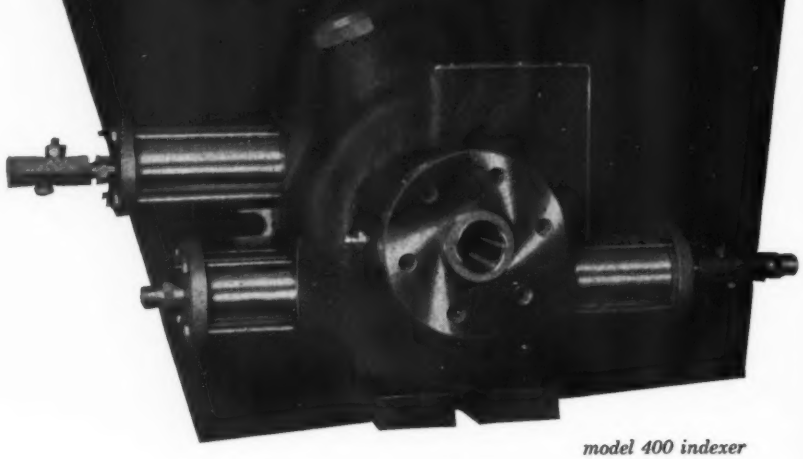
Better Products at Lower Cost through Better Methods

For speeding precision production

AUTOMATE

with

Erickson Indexers

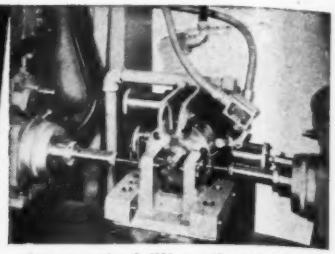


model 400 indexer

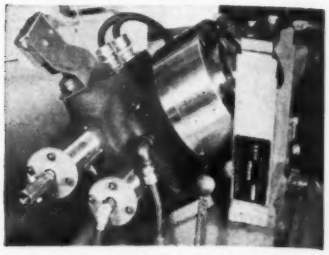
Perhaps these actual applications of automation will trigger your imagination . . . show you how Erickson Indexers can help you smash bottlenecks in your own production operation.

You can interlock them into production setups with microswitches and solenoid valves. And with Erickson Indexers you automatically get consistent positive positioning within 2 minutes of a degree . . . repetitive accuracy in low "tenths" of a thousandth.

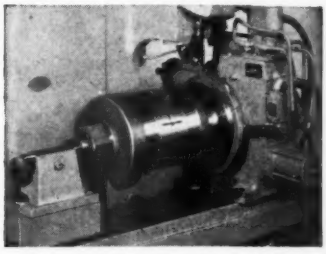
Speed to keep lines humming . . . accuracy to banish rejects . . . long life to slash maintenance and capital investment—all add up to Erickson Indexers. A-1662A



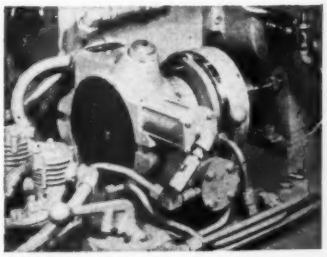
Automatic drilling of cross holes being done on Erickson Model 400 Speed Indexer with air cylinder and Expanding Drawbar Mandrel. Indexer equipped with interlock limit switches.



Angular drilling in jet part held in air operated collet chuck on Erickson indexer operating automatically. Entire fixture designed and built by Erickson.



Using end-clamping for half bearing, machine mills 8 oil grooves then skip indexes back to starting position for next part.



Milling four and six flats on needle valve part. Owing to size, part is placed in tail stock head-first, and tail stock then positions it in chuck and retracts.

ERICKSON TOOL COMPANY

34352 SOLON ROAD • SOLON, OHIO

COLLET CHUCKS • EXPANDING MANDRELS • AIR-OPERATED CHUCKS • FLOATING HOLDERS • TAP CHUCKS
• AUTOMATIC INDEXING • MASTER SPACERS • DIAPHRAGM CHUCKS • PUSH-ON ARBORS • QUICK-CHANGE HOLDERS
• EXPANDING COLLETS • END-CLAMPING CHUCKS • AIR CYLINDERS (allowing stock to pass through)
• EXPANDING JAW MANDRELS • SPECIAL HOLDING FIXTURES (including gear-holding)
• BORING BARS • SPADE DRILLS • RECESSING TOOLS

CIRCLE INFORM-A-GRAM KEY NO. 90

Catalogs . . .

A giant 19 x 28½" wall chart shows decimal equivalents, plus screw threads and tap drill sizes. It's offered free by Ash & Co., on Inform-A-Gram No. C21.

Wahlstrom drill chucks and Float-Lock vises for both drill press and band saw applications are offered in a folder from American Machine & Foundry Co., AMF Tool Div. Operating principles and diverse applications on drill presses, radial drills, boring mills and lathes are shown. Inform-A-Gram No. C22.

How to select the right abrasive media and compounds for grinding, deburring, descaling, polishing, britehoning and burnishing operations is discussed in a bulletin from The Roto-Finish Co. Inform-A-Gram No. C23.

The current issue of Die Set Digest, quarterly of the Producto Machine Co. illustrates quick-assembly die sets, special application die sets, ring punches and dies, and examples of plates and bolsters made to individual specifications of steel or semi-steel. Circle Inform-A-Gram No. C24.

Selecting the right drill jig bushings for every job is simple with the new drill jig bushing chart from Acme Industrial Co. Free copies on Inform-A-Gram No. C25.

Disc-Center brushes for high impact brushing prior to welding, weld cleaning, and metals preparation for painting, are outlined in a brochure from Osborn Mfg. Co. Check Inform-A-Gram No. C26.

Tube production equipment for coil handling, strip joining, strip guiding, strip forming, tube welding, oil cooled rotary transformer, tube finishing, tube cut-off, and pipe mills, is outlined in a 34-pager from McKay Machine Co. Inform-A-Gram No. C27.

Ferro-Tic*
" the only machinable carbide "
Draws 50,000 perfect stainless steel cups
Here's proof:
WOODHAVEN METAL STAMPING COMPANY, INC. states:
"Using steel dies to draw 305 stainless steel cups we had to rework the die after every 5,000 pieces. With FERRO-TIC dies we draw 50,000 pieces before even superficial polishing is needed."

FERRO-TIC is the only cemented carbide that is machinable and heat treatable. Fabrication is similar to tool steels; first conventional machining and then quench hardening for ultimate hardness. WOODHAVEN METAL STAMPING, like most **FERRO-TIC** users, make their own dies, with existing equipment, thus, insuring quick service to their customers. In addition to much longer press runs, parts from **FERRO-TIC** dies are within closer tolerances and have better appearance. Since only superficial polishing is required to renew these dies, their actual production life is more than a hundred times that of tool steel. **FERRO-TIC** can be used for blanking, deep drawing, heading dies, arbors, core rods, wear parts, etc.

AGENTS THROUGHOUT THE U. S. A.
WRITE FOR ILLUSTRATED BULLETIN P9

Sintercast

Division of **CHROMALLOY CORPORATION**
169 Western Highway, West Nyack, N. Y. • ELmwood 8-5900
Chromalloy Division, West Nyack, New York
Chromizing Corporation, Hawthorne, Calif.
Propellex Chemical Division, Edwardsville, Ill.
Elyria Foundry Division, Elyria, Ohio
Shunk Manufacturing Co. Inc., Bucyrus, Ohio

*Reg. U. S. Trade Mark

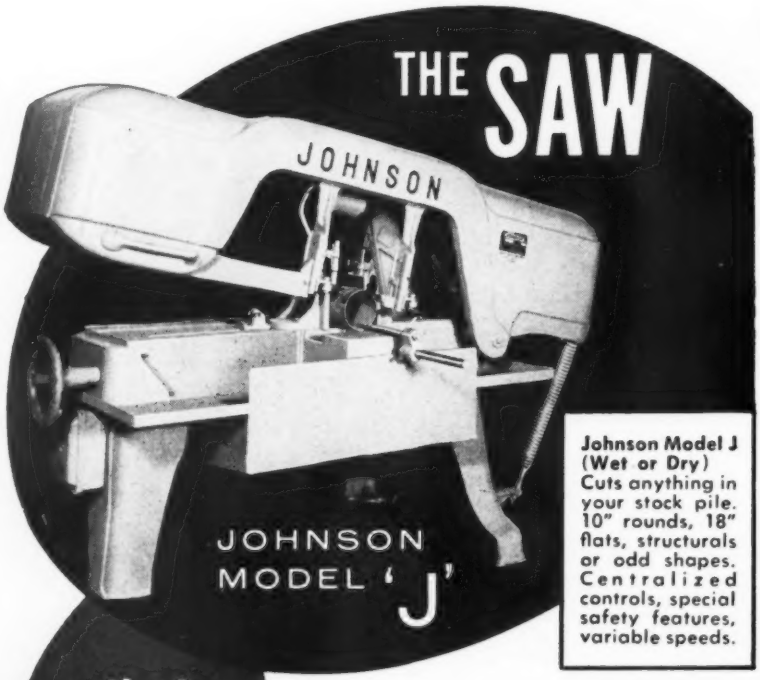
CIRCLE INFORM-A-GRAM KEY NO. 91

Catalogs . . .

Folder 222-16 contains specification data of "66 Bond" wheels for cutting off aluminum, steel, brass, bronze, cast iron, nickel, stainless, Stellite and other materials. Wheels are available, plain or reinforced, from Peninsular Grinding Wheel Co. Inform-A-Gram No. C28.

Precision grinding machines for a variety of parts from gage blocks to coil springs and cylinder heads are described in a 28-pager from Besly-Welles Corp. Inform-A-Gram No. C29.

Photoelectric tape reader Model PTR-71 from Omnitronics, Inc. reads punched or printed tapes at a high rate with fast start and stop. The company offers a specification sheet on the bi-directional reader. Inform-A-Gram No. C30.


THE SAW
JOHNSON
JOHNSON
MODEL 'J'
Johnson Model J (Wet or Dry) Cuts anything in your stock pile. 10" rounds, 18" flats, structurals or odd shapes. Centralized controls, special safety features, variable speeds.
that costs you NOTHING!

True, you pay the low initial purchase price, but the big, rugged Johnson Model J is so well engineered, so dependable, so troublefree—so versatile, fast and accurate, that it quickly pays for itself in tangible savings. One Johnson metal cutting band saw . . . or a battery of them, will pay you big dividends in time, labor—smooth production and eliminate scrap.

Write Today . . . for your copy of the new Johnson catalog.
All models and accessories described, illustrated in full.

Johnson MANUFACTURING CORPORATION

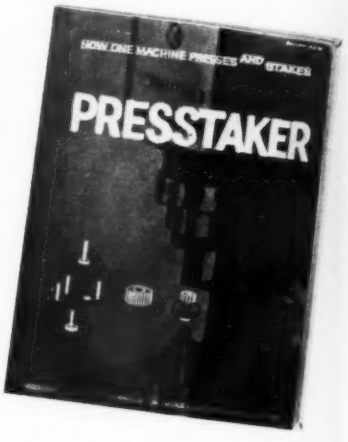
CIRCLE INFORM-A-GRAM KEY NO. 92

Circling Inform-A-Gram No. C31 will bring you Catalog 82 covering 32 pages of centralized lubrication equipment built by Lincoln Engineering Co.

Techniques for machining laminated plastics and illustrated design hints for laminates are shown in a brochure from Synthane Corp. Inform-A-Gram No. C32.

Extra heavy duty cast aluminum M/C Handy-Blocks hold work securely. They are described in a flyer from Magne-Cast Tool Co., Inc. Circle No. C33.

Circling Inform-A-Gram No. C34 will bring you Tool Products Corp.'s new catalog describing the company's full line of unitized tooling.



Bulletin CAS-2 describes a new kind of assembly tool that combines pressing and staking operations. Automatic and manual models as well as typical assemblies are illustrated. Machine Tool Dept., Cramer Div., Giannini Corp., Inform-A-Gram No. C35.

Denison, Denison HydrOILics, and Multipress are registered trademarks of Denison Eng. Div., ABSCO

DENISON HydrOILics

How **AUTOMATIC ELECTRIC** uses **DENISON** Multipress to form featherweight phone parts requiring unusually high...

PRECISION

PRECISION FORMING *of ultra-thin telephone diaphragms from .003" aluminum roll stock is done on this 50-ton Denison Multipress at Automatic Electric, Northlake, Ill. Operator removes finished parts with air tube to prevent damage to delicate edges. Completed diaphragms are shown at right*

PRECISION control and smooth, cushioned hydraulic pressure by this Denison Multipress solved a critical production problem for Automatic Electric, subsidiary of General Telephone & Electronics.

This small aluminum diaphragm is a vital component of Automatic Electric's new 810 telephone receiver. Weighing just a fraction of an ounce and only .003" *thin*, this fragile part proved extremely difficult to produce by ordinary pressing methods. But the job was a *natural* for this 50-ton Multipress—*a giant with a delicate touch.*

In one operation it automatically blanks, forms and perforates the diaphragms from .003" aluminum roll stock. Because of the extra rigidity and stability—as well as accurate control—finished parts come through in perfect shape, well within the .001" tolerance specified. No distortion of the thin diaphragm edges . . . no damage to the costly dies.

It's typical of how Multipress speeds production . . . reduces rejects . . . cuts costs on an endless range of pressing jobs. To learn what Multipress can do for *you*, ask your Denison Production Specialist about a **M**ultipress **A**nalysis **P**rogram in your plant *now*. It can help you **MAP** new ways to boost efficiency and save money in your pressworking operations.

DENISON ENGINEERING DIVISION
American Brake Shoe Company
1197 Dublin Road · Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC MULTIPRESS

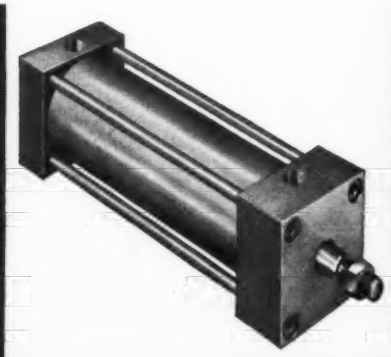
CIRCLE INFORM-A-GRAM KEY NO. 93

NEW FROM HANNIFIN

A GENERAL PURPOSE AIR CYLINDER

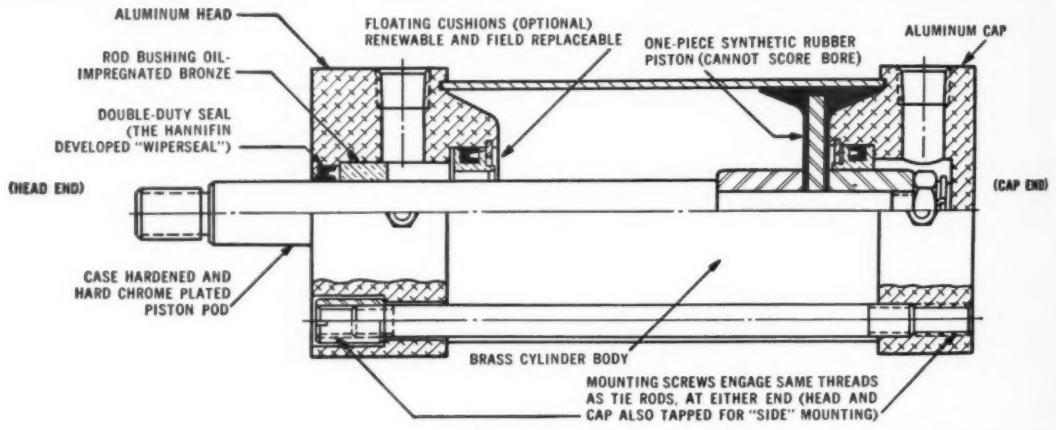
that gives you quality, low cost and mounting versatility

Hannifin announces a new design concept that gives you quality and economy in one package, the new Series "C" air power cylinder with . . .



- One compact basic design that provides side, cap end, or head end mounting without modification.
- Flange, foot or pivot mountings easily made with standard attachments.
- Rust proof construction — brass cylinder body, head and cap of aluminum.
- Cushions that do not change cylinder length — furnished as option or added in field with simple kit.
- An ingenious one-piece piston that cannot score the bore — of synthetic rubber, molded around a rugged steel disc.
- Piston rod both case hardened and hard chrome plated, polished to a fine finish for low friction and long seal life. Corrosion resistant.
- Rod bearing an oil-impregnated bronze bushing. Minimizes friction.
- Gland seal the Hannifin-developed "Wiperseal" — both a rod wiper and an efficient dynamic seal. It keeps air in, dirt out.
- 5 bore sizes — 1¼", 1¾", 2½", 3¼" and 4½". Stock strokes from 1" to 20" in 1" increments.

This new Hannifin cylinder design is the latest of the complete Hannifin line of air power cylinders. To help you choose the best Hannifin cylinder for your application, talk to your nearby Parker-Hannifin man. He knows cylinders!


ALUMINUM HEAD
ROD BUSHING OIL-IMPREGNATED BRONZE
DOUBLE-DUTY SEAL (THE HANNIFIN DEVELOPED "WIPERSEAL")
FLOATING CUSHIONS (OPTIONAL) RENEWABLE AND FIELD REPLACEABLE
ONE-PIECE SYNTHETIC RUBBER PISTON (CANNOT SCORE BORE)
ALUMINUM CAP
(HEAD END)
(CAP END)
CASE HARDENED AND HARD CHROME PLATED PISTON POD
BRASS CYLINDER BODY
MOUNTING SCREWS ENGAGE SAME THREADS AS TIE RODS, AT EITHER END (HEAD AND CAP ALSO TAPPED FOR "SIDE" MOUNTING)

PARKER-HANNIFIN

PARKER HANNIFIN CORPORATION

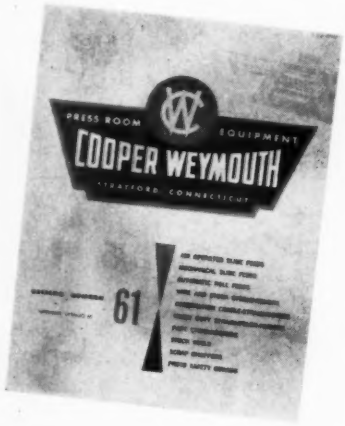
HANNIFIN COMPANY DIVISION
563 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

8420-PH EUROPEAN DIVISION • PARKER-HANNIFIN N.V. • SCHIPHOL • THE NETHERLANDS

CIRCLE INFORM-A-GRAM KEY NO. 94

Catalogs . . .

An electrically controlled system prevents damage to dies on power presses. It disengages the press clutch in the event of misfeed, stock buckling, material pile-up, or coil coming to an end. Di-Matic Controls, Inc. offers a brochure through Inform-A-Gram No. C36.



Air operated slide feeds, mechanical slide feeds, automatic roll feeds, wire and stock straighteners, stock reels, scrap choppers, and press safety guards all appear in Catalog 61 from Cooper Weymouth, Inc. Inform-A-Gram No. C37.

A new wall chart illustrating all steps in the installation of Veelos adjustable V-belt has been published by Manheim Mfg. & Belting Co. Inform-A-Gram No. C38.

An approach to automation based upon "unit mechanization" of specific and related work functions, rather than the fully automatic production line concept, is described in a brochure from Jered Equipment Co. Inform-A-Gram No. C39.

"Standard Shapes, Sizes, Grades and Designations of Cemented Carbide Products," is the title of Simplified Practice Recommendation, R263-60, issued by the Commodity Standards Div., U. S. Dept. of Commerce. Free on Inform-A-Gram No. C40 courtesy Cemented Carbide Producers Assn.

A new series of heavy duty ball bearing pillow blocks with self-aligning, single row, deep-groove, precision ball bearings in a complete range of shaft sizes from ⅝ to 4″ is outlined in Folder 2951 from Link-Belt Co. Inform-A-Gram No. C41.

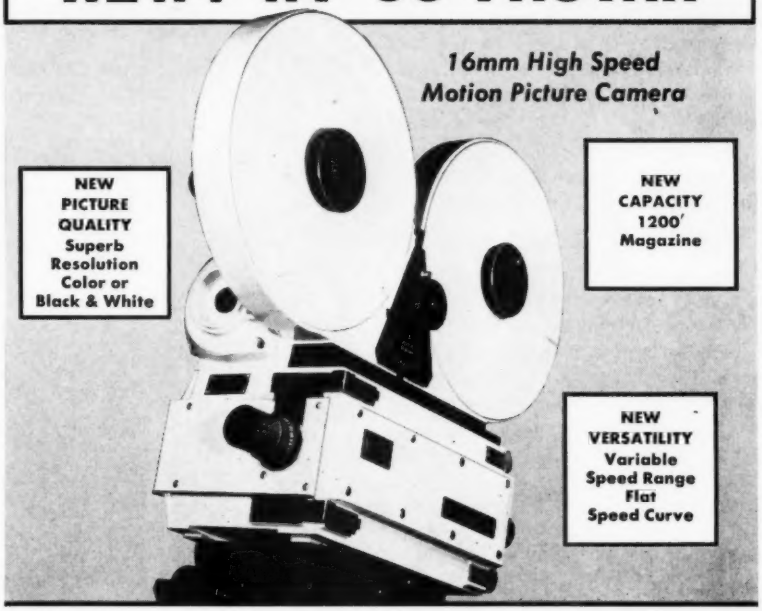
Soft vise jaws that snap into place without benefit of springs, clips, screws, or tools, are featured in a bulletin from Magne-Cast Tool Co. Inform-A-Gram No. C42.

Sulphurized base #245 offers high film strength and lubricity for deep hole tapping and similar operations on stringy alloys. Baker/Gubbins Co., offers a bulletin on Inform-A-Gram No. C43.

Centering tools, revolving stops, turret bushings, full-floating reamer bushings, drill holder bushings, slotting bushings, and adapters are outlined in a new screw machine tool brochure from Mueller Industries. Inform-A-Gram No. C44.

NEW! WF-30 FASTAX

16mm High Speed Motion Picture Camera



NEW PICTURE QUALITY Superb Resolution Color or Black & White

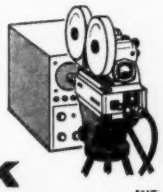
NEW CAPACITY 1200′ Magazine

NEW VERSATILITY Variable Speed Range Flat Speed Curve

Years Ahead in Design and Performance

A high speed camera with large film capacity . . . with a variety of speed ranges and high resolution has long been wanted by industry, the military and the government. The FASTAX WF-30 fills all these requirements and more. Darkroom loaded, "T" core, the magazine holds sufficient film for most studies. Camera versatility is another key feature. Variable speed range, controlled by a solid state loop servo device . . . rapid acceleration with flat speed curve within ±4% selected rate . . . start-stop capabilities. Superb resolution over entire frame results from excellent lens system and a sector shutter between rotating prism and focal plane.

WRITE for complete information and prices on WF-30 . . . the newest FASTAX in the wide line of Wollensak high speed motion picture cameras.



WF-32 OSCILLOGRAPHIC RECORDER

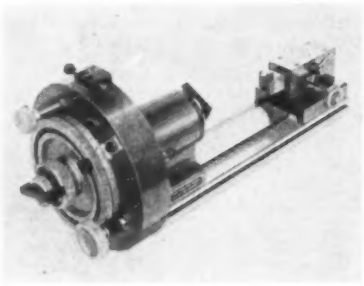
FOR THE FINEST IN PHOTOGRAPHY THE WORLD OVER · IT'S WOLLENSAK ·

WOLLENSAK OPTICAL COMPANY · ROCHESTER 21, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 95

T&P Product News

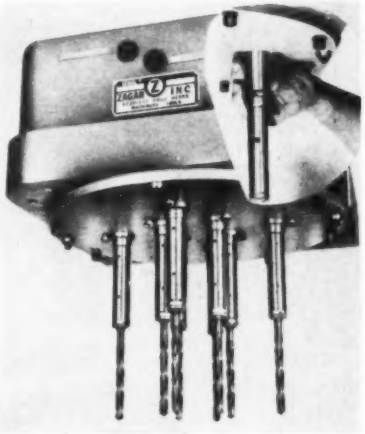
Peak Precision



Moore Precision Index Center assures finer tolerances in inspection of work on centers, and in jig boring, milling, and jig grinding work on centers. The units also achieve peak precision for form grinding of spiders, splined punches, gear die punches and dies, and sectional parts of dies. Major features include a special ball construction spindle, lapped-fit, 192 balls 5 millionths tolerance under load. It runs true to 15 millionths T.I.R. An extra plug-in-station allows turning of workpiece exactly 180° at any time. Sealed against dirt, the Precision Index Center can also be used in wet grinding. Write Moore Special Tool Co., Inc., Bridgeport 7, Conn., or circle Inform-A-Gram No. P1.

Slip Spindles

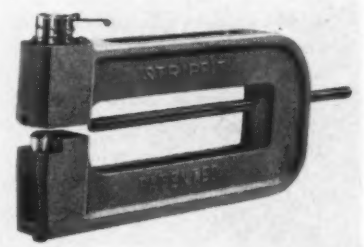
Zagar multiple spindle gearless heads for drilling, reaming and tapping are now equipped with slip- or cartridge-type spindles. The spindle plate is pre-bored and accepts spindles in varying patterns. Insertion or removal of spindles is simple, yet rigidity and accuracy of fixed center drilling is maintained. Heads are very adaptable since they have no gears or joints. Minimum spindle extension is required and overall height of the smallest head size is a mere 7¾". Spindle sizes are 1¼ and 1½" with capacity up to 9/16" in steel. The standard heads mount on round or flange-type quill ma-



chines. Write Zagar Inc., 23894 Lakeland Blvd., Cleveland 23, Ohio, or mark No. P2.

Threaded Gage Rod

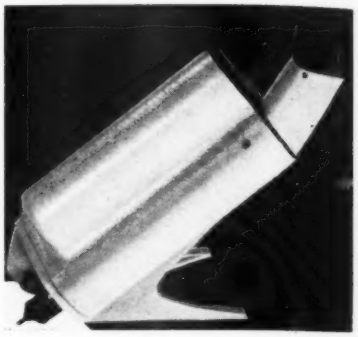
A positive locking, threaded gage rod is a new accessory for many self contained sheet metal hole punching and notching units from Wales-Strippit, Inc., 212 S. Buell Rd., Akron, N.Y. BN ¾ and BN 1¼, CJ-1 and CJ-⅜ units feature a tapped hole. The positive locking, threaded gage rod can be accurately adjusted and locked securely with a lock nut. Gage rods are primarily used with smaller units where most punching is close to



the edge of small metal parts. For complete information write, or mark Inform-A-Gram No. P3.

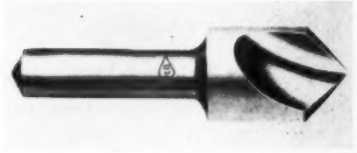
Die-Wear Detector

A new die-wear microscope, originally designed to a customer's specifications, is now available to the industry. With the unit one can quickly determine the exact amount of metal to be ground away for resharpening the cutting edge. (The simulated recticule shows the precise profile and actual character of wear, as illustrated). The microscope measures die-wear over a



range of 0.020 to an accuracy of ±0.0005 or 10% of the depth, whichever is greater. The instrument also measures bevels, burrs, and fillets. The unit is portable and requires no awkward setups. A hardened and ground guide contacts the die edge to be measured and positions the microscope automatically for best viewing. The guide fits holes as small as 3/32" dia or slots 3/16" wide. Bausch & Lomb, Inc., Rochester 2, N.Y. will supply Bulletin D-2015, or check Inform-A-Gram No. P4.

Countersink



High speed countersinks for machine use and light portable work feature single flute construction. They provide easy feeding, smooth burr-free holes, and chatterless operations over a wide range of speeds and in a variety of materials. Sizes available are ¼, ⅜, ½ and 1" with included point angles of 60, 82, and 90°. For more information contact Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich., or circle Inform-A-Gram No. P5.

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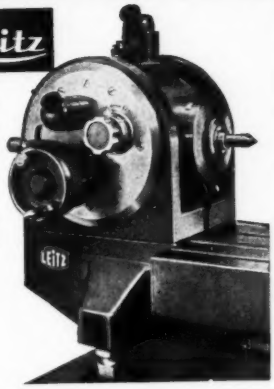
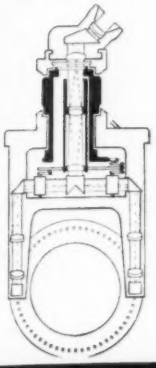
Leitz

Ultra Precision Spacing on guided missile components and similar critical work guaranteed by this exclusive DOUBLE-MICROSCOPIC PICK-UP of the LEITZ OPTICAL MASTER DIVIDING HEAD.





It compensates for runout, the most common source of error. Working accuracy ± 1 second of arc.

There is no substitute for LEITZ in optical dividing.

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NEW!

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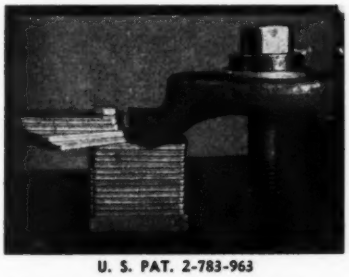

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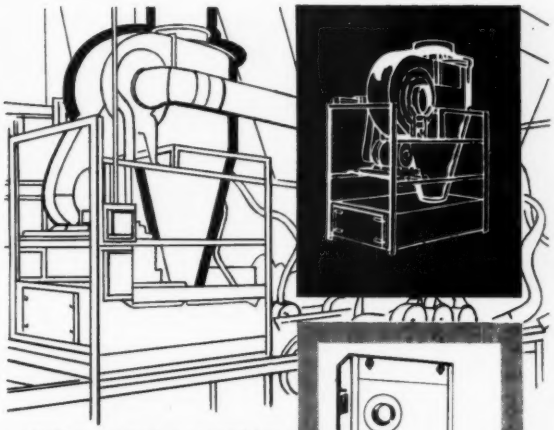

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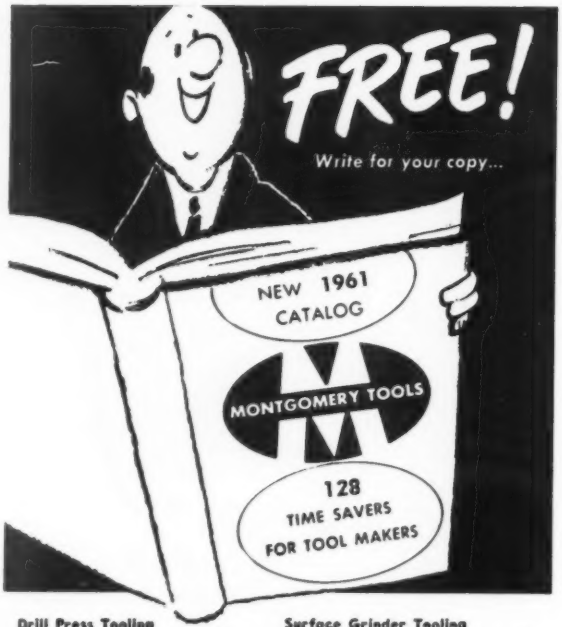

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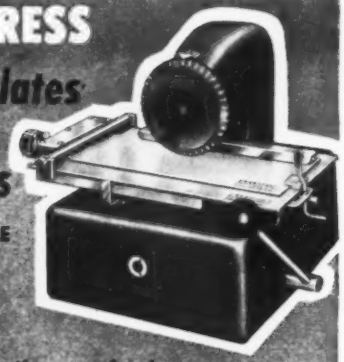
for Nameplates and Small Parts



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GENESEE...
ALIGNING TYPE HOLLOW MILLS

Genesee Aligning Type Hollow Mills are designed primarily for use on Brown & Sharpe and Davenport Automatics and are made with straight shanks to suit these machines.

Any misalignment in the machine may be easily corrected by the aligning feature built into the hollow mill, these mills eliminate separate holders and shorten tool overhang.

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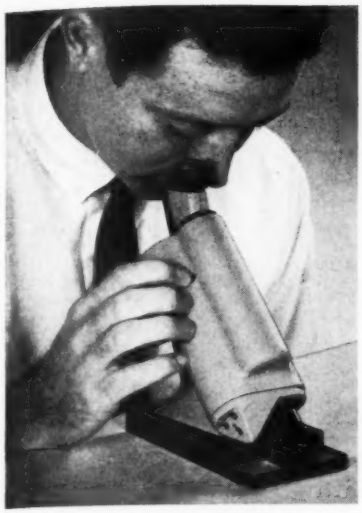

HOW WORN THE DIE?

Save the high cost of excess grinding . . . measure with this New Bausch & Lomb Die-Wear Microscope

Every time you sharpen a die you pay for down time and grind away some of its useful life. But now B&L makes it easy to see whether the tool *needs* sharpening, and *exactly* how much metal must be removed to achieve the correct degree of sharpness.

The calibrated reticle of this ingenious new microscope gives you direct, easy-to-read measurement of die-wear up to 0.020", accurate to 0.001". So lightweight and compact, you can carry it to any job, position it for any set-up. And so versatile, it can measure burrs, bevels and fillets. It will *pay you* to find out more about it soon.

BAUSCH & LOMB SINCE 1853

BAUSCH & LOMB INCORPORATED
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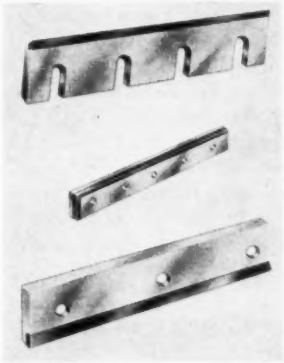
Product News

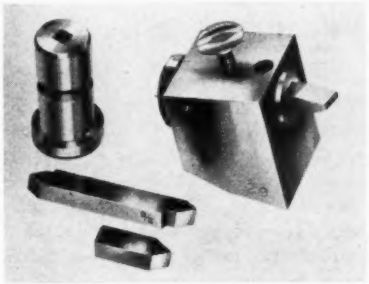
Long Wear and High Speed



O-Kni-Co tungsten carbide knives cut all types of iron, steel and non-ferrous alloys. They're also widely used in high production slicing of thick sheets of plastics, formica, rubber, synthetics, and other non-metallics at extremely close tolerances. The knives are extremely accurate over long runs in high speed cutting, shearing and granulating operations. Ohio Knife Co., Dreman at B & O RR, Dept LL, Cincinnati 23, Ohio will furnish more information, or circle No. P6.

Grinding Threads

Precision threads for internal and external V60° and Acme 29° can be ground quickly with the MRCO fixture. The unit mounts on a surface grinder. Even an inexperienced operator can grind standard or short tool bits, or extra short internal threading with a



boring bar. Model A block handles separate barrels for 3/16, 1/4, 5/16 and 3/8" square tool bits. Model B handles the barrels for 1/2 and 5/8" square bits. Round bit holders are available according to MRCO Tools Co., 2742 Chene St., Detroit 7, Mich. Check No. P7.

HOW DEEP THE SCRATCH?

Find out fast if it's within tolerance . . . measure with this New Bausch & Lomb Scratch Depth Gage

Here's real help in checking surface flaws. Are they serious enough to threaten functional failure under stress, in such materials as airplane wing skins or high pressure tubing? Are they within quality control limits? This new B&L inspection aid shows you quickly, simply . . . and for *sure*. Get direct readings of depths from 0.0002" to 0.016", accurate to +0.0001" or 5% of the depth, whichever is larger. Measure widths from 0.001" to 0.050", accurate to +0.001". You get a clear view of indentation contours, even edge burrs. If surface inspection is significant in your operation, mail this coupon right away.

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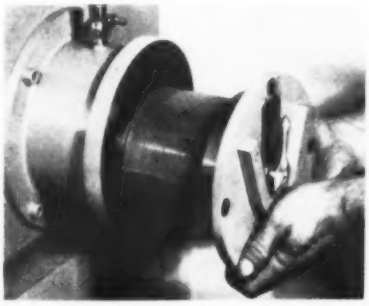
CIRCLE INFORM-A-GRAM KEY NO. 992

Product News

Tell Tale

This submersible filter projects through a hole in the wall of the tank. The dirt indicator on the cover plate shows when the filter needs cleaning. The filter can be cleaned from outside without draining the tank. The outlet pipe



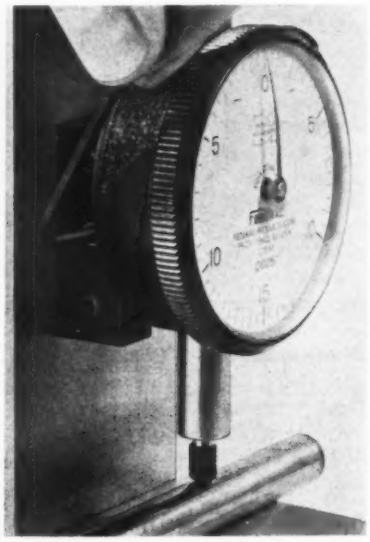
can come out of the top, the bottom, or out either end via a single elbow. The Rosaen Co., 1776 E. Nine Mile Rd., Hazel Park, Mich. offers Tell Tale in four sizes, at 30, 60, 100, and 200 gpm. Write for added data, or mark Inform-A-Gram No. P8.

One Shot Clutch

Air powered nutrunning and screwdriving will be simplified with series 21F and 22F fastening tools. The tools feature a spring-loaded torque control clutch with just a single pulse of torque for better quality control. Added results are longer life for the bit or socket, and less marring of the workpiece due to less bit slippage. Seen is the smallest and lightest tool made with a spring-loaded torque control clutch. Its torque range is infinitely adjustable and its speed range of 500 to 1800 rpm makes it particularly effective on #10 screws and smaller. For more information write Buckeye Tools Corp., 5003 Springboro Pike, Dayton 1, Ohio, or circle Inform-A-Gram No. P9.

Indicator Bracket

Federal dial indicators can now be easily mounted and positioned with a new adjustable bracket. The assembly saves time in setups, because position adjusts over a ⅞" range and locks positively. The indicator is equipped with a dovetail back that fits into a mating dovetail mounting bracket. A rack and pinion adjusts the indicator and locks by tightening two large clamping screws. The mounting bracket comes in two models AGD group one or two Federal indica-



tors. Special adapters allow mounting of other size indicators and other devices. More from Federal Products Corp., Providence, 1, R.I., or Inform-A-Gram No. P10.

Helical Blade Cutters

Helicarb shank and shell end mills for Milwaukee-matic and other tape-controlled milling machines have been introduced by Sonnet Tool & Mfg. Co., 576 N. Prairie Ave., Hawthorne, Calif. The cutters feature inserted helical carbide blades with serrated backs that fit into matching serrations on the cutter bodies. This permits presetting of blades in the toolroom. A constant cutting diameter, demanded by the tape program is maintained. The cutters are available in sizes from 1½" diameter and larger. They're used for cutting aluminum, magnesium, brass,

Ballizing Press

As many as 100,000 pieces can be sized before replacement of a low cost ball on the new Ball-O-Matic press. The machine reduces cost of high speed hole sizing. It delivers fine micro finishes at low tool and maintenance cost. The machine's ball return and a rotary

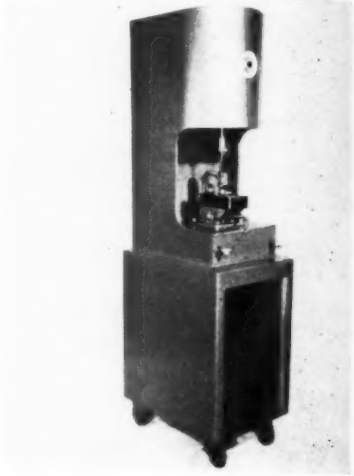
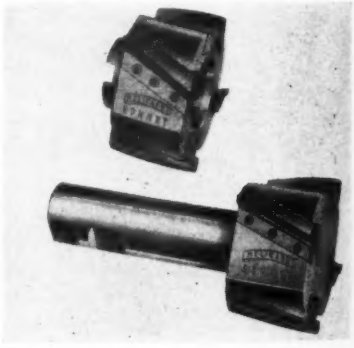


table facilitate hand feeding of parts at 1200 to 1800 pcs/hr. Hopper and feed track rate is 5000 pcs/hr. Interchangeable ball tracks and nest provide a wide hole size range from ⅛ to ½" ID. The unit is offered by French Enterprises, 22050 Telegraph Rd., Detroit 41, Mich., either as floor or bench style. Hand controls and hand feed, semi-automatic, or automatic styles are available. Write the makers, or circle No. P11.



bronze, cast iron, steel and stainless steel. Write the makers, or mark Inform-A-Gram No. P12.

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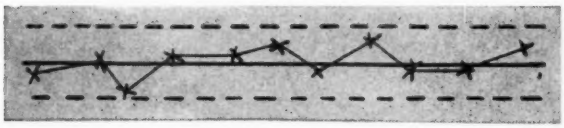

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Comtorplug indicates the actual dimension, easily readable to .00005".

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Not a passing approximation, Comtorplug gives a fixed reading of the actual dimension.

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Built-in features assure that various operators get the identical reading. Comtorplug automatically gives: self-alignment, self-centering and uniform gaging pressure.

2-POINT GAGING

Automatic 2-point contact permits taking the diameter at any point, front to back as well as axially. Thus Comtorplug detects front or back taper, ovality, etc., and shows the exact amount of the deviation.

Request Bulletin 51

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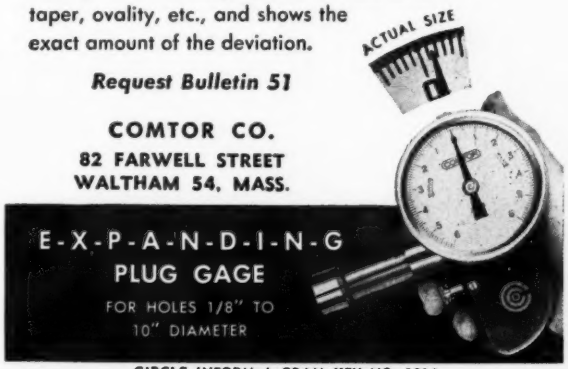
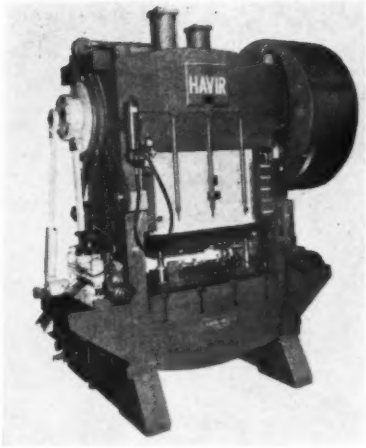


CIRCLE INFORM-A-GRAM KEY NO. 1014

Product News

Heavy Auto Press

A new high-speed 150-ton automatic press features an exclusive cylindrical ram for precision alignment. Die life is said to increase 50% over conventional presses. The cylindrical ram with its maximum guiding surface insures proper guiding of ram, punch and die. Costly die breakage is prevented due to automatic stops in the event of a die-jam or misfeeding. The press has standard operational speeds of 70 to 210 strokes/min using an 18" wide feed. The auto-feed is especially engineered for the press. The air-clamped feeds prevent stock distortion and allow infinite controllable variations of roller pressure. Bed width



front-to-back is 32" and bed opening is 30 x 18" or 46 x 18". Length of ram is 28 x 32". For further information write Havir Mfg. Co., 444 N. Cleveland Ave., St. Paul, Minn., or check Inform-A-Gram No. P13.

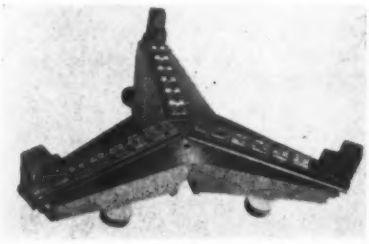
Remote Controlled Drum

The depth stop drum on Burg Model 3BHT and 3BHT-L tape controlled turret drills has been mounted on the operator's control station. This brings depth stops and cams within 60" from floor on 3BHT and 72" on 3BHT-L. The newly designed control station to the left of the control drum has a feed rate meter that indicates spindle feed rate at all times. Speed and cycle control knobs, pre-selective spindle feed control knobs and push buttons are on the right of the drum. All functions of the machine are represented on the central station, allowing easy setups and hand and automatic operation. The new features are completely described in a brochure from

Burgmaster Corp., 15001 S. Figueroa St., Gardena, Calif. Inform-A-Gram No. P14.

Self Centered Holds

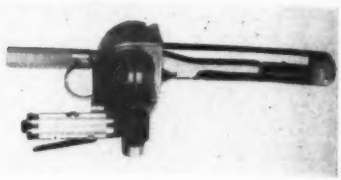
A fast and accurate positioning device for welding and flame



hardening has three hardened steel jaws. The self-centering positioner has a capacity from 3 to 40". Jaws open and close at a turn of a wrench and work is automatically centered. The unit mounts on headstock, turntable, or positioner, and can be fitted with special jaws for special applications. Complete details from Skinner - Horton Chuck Div., New Britain, Conn., or Inform-A-Gram No. P15.

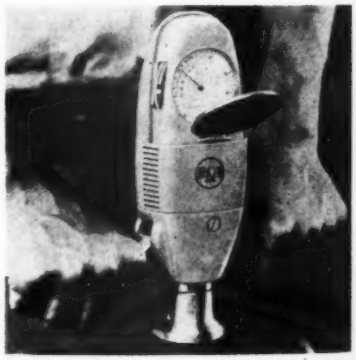
Saber Belt Sander

This was originally a custom built unit, designed specifically for sanding inside edges of new die cast dash panels. It proved so adaptable to numerous applications that it has been made a member of the standard line of The Rotor Tool Co., 26300 Lakeland Blvd., Cleveland 32, Ohio. The sander has a speed of 6200 fpm with a governed motor. It's equipped with a positive belt tracking adjustment, with a spring loaded maximum belt tension of 40 lbs. Further data from the manufacturer, or on Inform-A-Gram No. P16.



Portable Hardness Tester

This instrument works as a bench unit for inspecting small parts and as a portable one for checking hardness of large objects, even those with complicated contours. Readings are given in both Vickers (40-1000) and Rockwell C scales (20-70). The instrument checks steel, aluminum, or copper in thicknesses of more than 0.6 mm. Overall height with stand or frame is 10½". Standard accessories include a flat anvil, V-anvil, inclined bed and gage and an in-



denter adjusting tool. Radio Corporation of America, Industrial and Automation Div., 12605 Arnold Ave., Detroit 39, Mich. is the manufacturer. Write, or check Inform-A-Gram No. P17.

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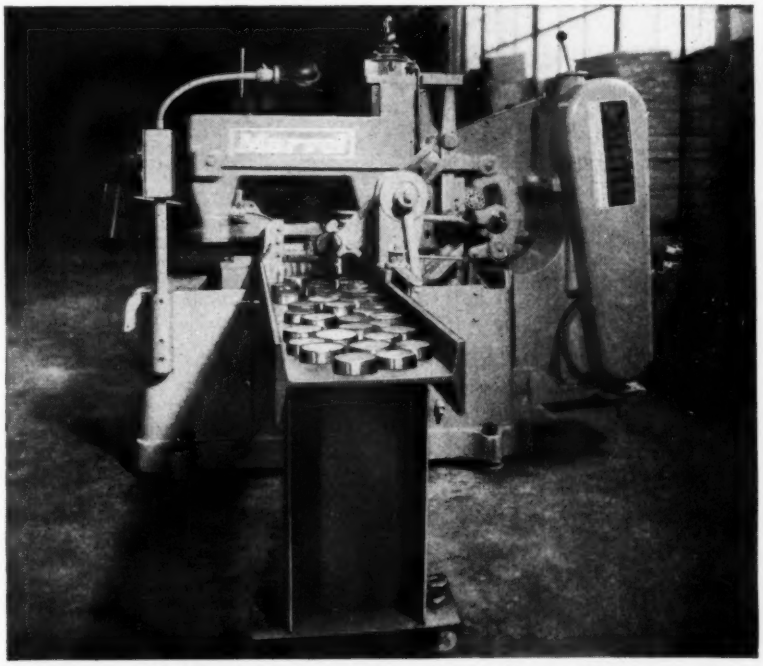

Payoff End of a Production Marvel

A cut-off saw's value is proven at the discharge end of the machine. How quickly the trough is filled with accurately cut-off pieces can mean the difference between profit and loss on many jobs.

The R. J. Sudrick Co., Des Plaines, Illinois, manufacturers of precision aircraft components had to cut-off 4600 blanks from 3¼" round, 303 Stainless Steel Bars.

They bought our MARVEL No. 6A4 High Speed Heavy Duty Automatic Bar Feed Hack Saw Machine; used MARVEL High-Speed-Edge Hack Saw Blades, and got the high production, accuracy and economy they desired.

PRODUCTION? Constant at 20 pieces per hour floor to floor

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BLADE COST? Just 1½¢ per cut. Only twenty-three MARVEL blades were needed to make the 4600 cuts, and not a single blade failure due to blade breakage. MARVEL High-Speed-Edge Blades are unbreakable.

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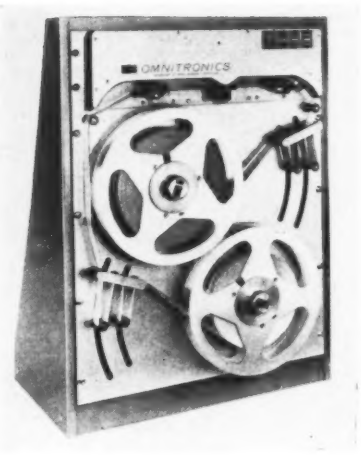
MARVEL Metal Cutting SAWS
Better Machines Better Blades

CIRCLE INFORM-A-GRAM KEY NO. 1034

Product News

Speedy Tape Handler

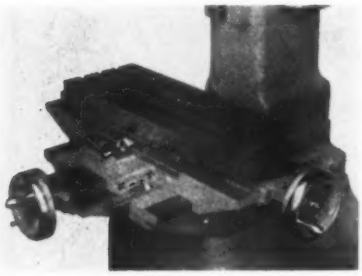
Model RS-400 tape reeler handles tape in two directions. It permits dependable tape supply and transport with either 8 or 10½″ dia reels. It operates at any tape speed in either direction up to 60 ips under tape reader control. The unit can be rack or cabinet mounted. It's usable with Omnitronics tape reader PTR-7 or PTR-71 or operable as a modular unit adaptable to other systems. Spring loaded tension arms feed the tape and maintain constant tape tension and slack takeup under all conditions. RS-400 operates on 120 volts ±10%, 60 cps single phase at 210



watts. Omnitronics, Inc., 511 N. Broad St., Philadelphia 23, Pa. will supply Bulletin RS-400, or circle Inform-A-Gram No. P18.

Changes Mean Improvement

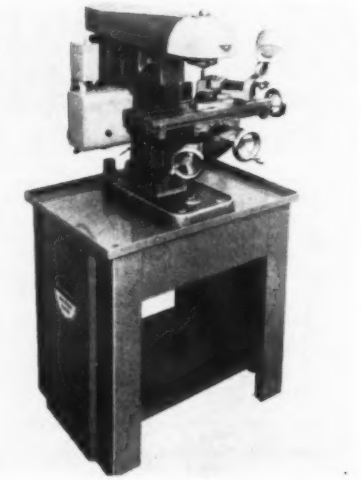
Model 1A Linley jig boring machine is the result of important



improvements made to the original unit. The machine's table bearing area has been increased 400% and the saddle bearing area doubled. Width of base ways was doubled and all overhang eliminated. Table size and movement are 7 x 17½″ and 6½ x 10″ respectively. Easy reading reference scale allows positioning without counting hand wheel turns. Linley Brothers Co., 682 State St. Extension, Bridgeport 1, Conn. will furnish additional data and literature. Inform-A-Gram No. P19.

Package Mill

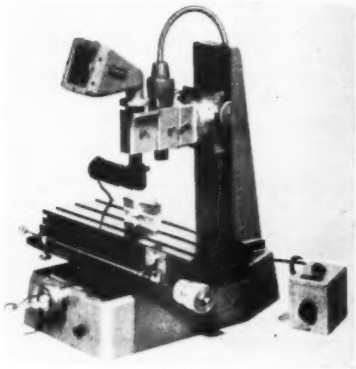
The Benchmaster combination horizontal and vertical mill is now offered as a "package" unit. This includes all electricals, motor, machinist's light, 3-phase push button switch, forward-reverse switch and magnetic starter. The unit has a table travel of 12½″ and a table size of 6 x 18″. A choice of 2 interchangeable spindle assemblies facilitate both vertical and horizontal milling operations on the same machine. Accessories include an independent table power feed unit, arbors, overarm support brackets, rotary tables, vises, collets, and floor stand. Write Benchmaster Mfg. Co., 1835 W. Rosecrans Ave., Gardena, Calif., or circle Inform-



A-Gram No. P20.

Sees All

Linearscope provides interchangeable microscope or projection screen optics. The instrument tackles accurate measuring tasks of large parts previously difficult to check by any method. Linearscope also measures internal diameters, depths of internal grooves, and internal radii. Measuring capacity is 4 x 12″ in one setting and



direct micrometer read-outs are 0.0005 and 0.0001 with the tenths readings in the longitudinal (12″ travel) direction. A 3 x 3″ projection viewing screen with separate high intensity illuminator for rapid production checking is available in addition to the regular 20X or 40X monocular microscope eyepiece. Write Stocker & Yale, Inc., 143 Green St., Marblehead, Mass., or mark Inform-A-Gram No. P21.

Threaded Expanding Mandrels

New threaded mandrels have joined the family of standard expanding mandrels at Le-Count Tool Works, Inc., P.O. Box 252, Cheshire, Conn. The units are designed to hold work on the pitch diameter of internal threads and can be used for machining, grinding, balancing, and inspection. Jaws of the mandrels remain parallel through their expansion range, which allows machining and inspection of parts at extremely close tolerances for both concentricity and squareness in relationship to the right pitch diameter. Write the manufacturer, or circle Inform-A-Gram No. P22.

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CONTINUOUS

SMALL HOLE

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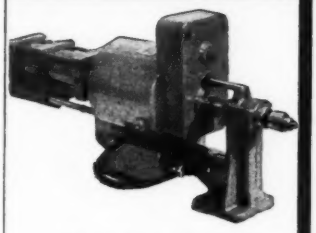

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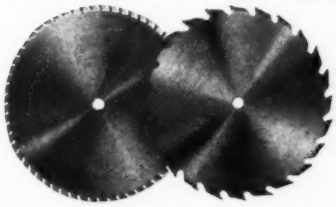

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WRITE FOR BULLETIN NO. 21

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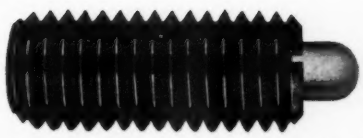

SPRING PLUNGERS are now available in four types and thirty-four sizes. Black Pentrate Nose with standard spring pressures, 6-32 thru 1"-8 threads. Cadmium Plate Nose with light spring pressures, 6-32 thru 1"-8 threads. Black Nylon Nose with standard spring pressures, 8-32 thru 5/8"-11 threads. White Nylon Nose with light spring pressures, 8-32 thru 5/8"-11 threads. Northwestern Tools, Inc., 122 Hollier Ave., Dayton 3, Ohio.

PLASTIC BALL KNOBS with brass inserts are now available in four diameters and twelve thread sizes. 3/4" diameter with 10-32 threads. 1" diameter with 1/4-20, 1/4-28, 5/16-18 or 5/16-24 threads. 1 3/8" diameter with 3/8-16, 3/8-24, 1/2-13 or 1/2-20 threads. 1 7/8" diameter with 1/2-13, 1/2-20 or 5/8-18 threads. Northwestern Tools, Inc. 122 Hollier Ave., Dayton 3, Ohio.

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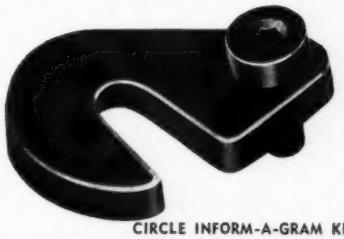

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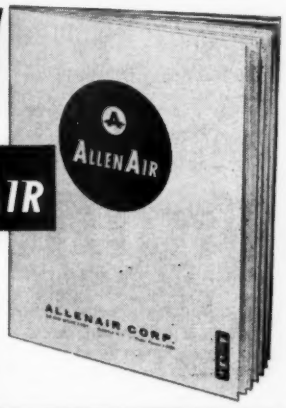

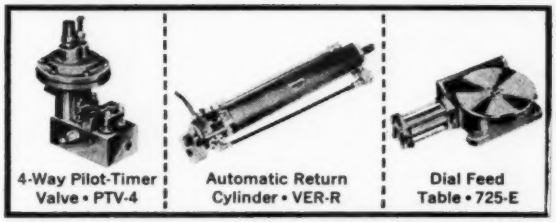

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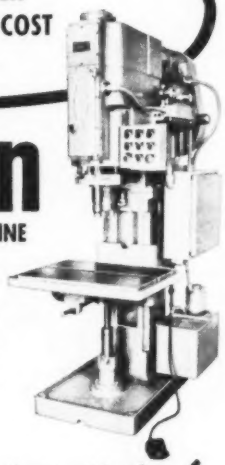

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CIRCLE INFORM-A-GRAM KEY NO. 1071

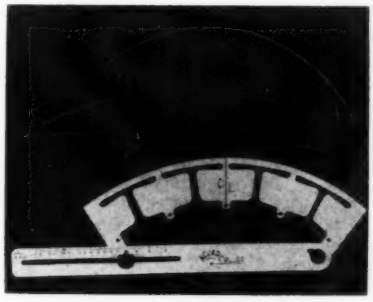
Product News

Gearless Drill Speeders

Tapmatic Drill Speeder Model 62 performs small hole drilling on machines with relatively low maximum spindle speeds. The unit has a standard ratio of 7:1 and has major dia of 1 5/16", although it weighs only 9 oz. Drilling speeds up to 22,500 rpm are possible even on machines with maximum spindle speeds of only 1500 rpm. The drill speeder is manufactured with threaded or tapered mounts for universal application on all types of manual, semi or completely automated drilling machines. Write Tapmatic Corp., 845 W. 16th St., Costa Mesa, Calif., or mark Inform-A-Gram No. P23.

Draws Big Circles

Arcs and circles of any radius from 7 to 200" can be drawn with ease with the new Acu-Arc ruler. The tool eliminates need for a beam compass, highway curves, ship's curves, splines and weights, or the various other tedious tools used for drawing arcs. A movable



pointer on a scale gives the exact arc required. Center lines, center points and radii for arcs already drawn can be quickly determined with Acu-Arc, according to Hoyle Engineering Co., 25408 W. Hwy. 66, Barstow, Calif. Inform-A-Gram No. P24.

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CHUCKING
SINGLE POINT THREADING

Costs { $7,167.00 FOB Factory Complete with all standard equipment

This is an all new 1½" bar capacity ram type turret lathe with power feeds to all 8 working stations . . . that in addition to bar and collet work also has the versatility to do chucking, and when needed, single point threading. Powered by a 5 h.p., two-speed, geared motor, the new Sheldon 3 R turret lathe provides 16 spindle speeds, 60 different feeds to the carriage and cross-slide, and 180 different feeds to the ram turret.
The turret itself is ruggedly built and accurately machined to provide close tolerance indexing. And for complete ease of operation, it is put under power by simply pressing a push button on the control panel.

This new 3 R Sheldon is completely equipped with two-speed motor and electrical controls, coolant system and splash guards, LO spindle nose, large satin chrome dials and hardened bed ways. It also provides an additional cost saving feature—each turret face is drilled and tapped for your standard flange type tooling as well as being bored for your standard 1½" shank type tooling.
For versatile, accurate machining in either long or short runs, the new Sheldon 3 R provides the answer to low investment cost with high profit operation.

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3R-TURRET LATHE

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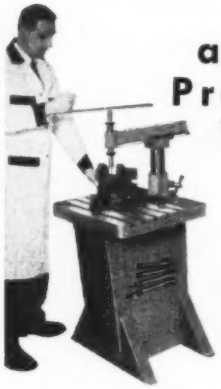

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TAP PERFECT HOLES—FAST!

- Rapid positioning over entire table area
- Floating tap finds true hole center
- Produces straight tapped holes

TOOLROOM EQUIPMENT DIVISION
THE PRODUCTO MACHINE COMPANY
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Product News

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Deeper taps can be made with a new spring for use on #2 or ¾" sizes of the Burr-Bit hole deburring device. The spring can be used with all tap chucks and holders. After removal of the stop collar on Burr-Bit, the spring can even be employed on holders that grip the entire shank. The new spring is shorter than previous ones, allowing axial adjustment of the Burr-Bit. Downward adjustment results in more chamfer and upward in less. All Burr-Bits now feature the new spring. Write Vernon Devices, Inc., 481 East Third St., Mount Vernon, N.Y., or circle Inform-A-Gram No. P26.

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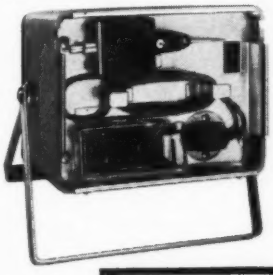

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No. 2B Heavy duty 4" Angle Vise

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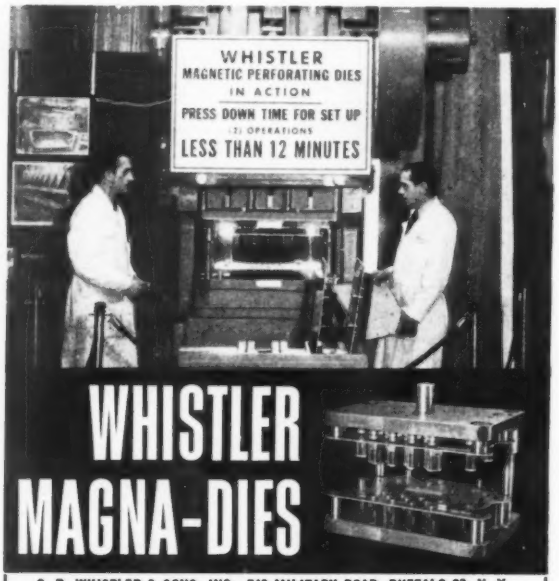

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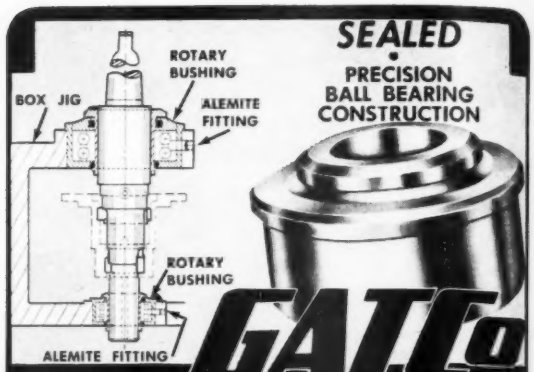

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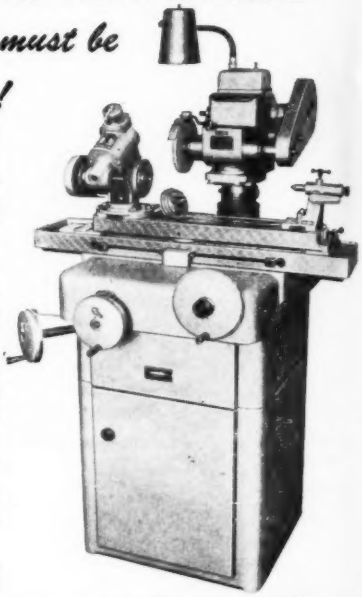


Model BA960 shown with B943 Motor Driven Work Head available at extra cost.

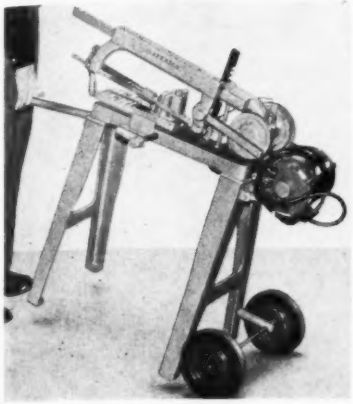
K.O. Lee Co.

ABERDEEN, SOUTH DAKOTA

CIRCLE INFORM-A-GRAM KEY NO. 1104

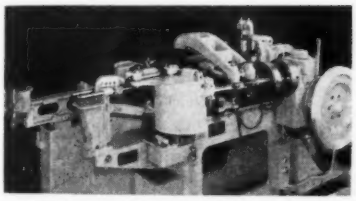
Product News

Power Hacksaw



A portable floor model of Jefferson 601 power hacksaw has been added to the Keller family by Sales Service Mfg. Co., 2363 University Ave., St. Paul 14, Minn. The saw capacity is 5″ wide by 4″ deep with a fast acting swivel vise that permits sawing any angle to 45° on material up to 3¼″ wide. Stroke is 3¾″ and 10 or 12″ blades may be used. Standard equipment includes a ¼ hp, 1725 rpm motor on a built-on motor mount, drive pulley and V-belt. Write the maker, or circle No. P27.

Stampings for Less



Costs per piece of formed stampings can be reduced with the new U. S. Model MS-28-HS Multi-Slides. The units attain outputs of 400 strokes/min. Die heads are reversible and can be used from either front or back. Standard equipment includes one complete die head with cam, back plate, tie bar, 4 high speed forming slides with cams, stripper mechanism with cam, high speed, positive grip type feed, stock check, stock straightener, brake, automatic lubrication system, 5-hp variable speed drive with outputs from 80-400 strokes/min. U. S. Tool Co., Inc., Ampere (East Orange) N.J., or Inform-A-Gram No. P28.

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A SPECIALIZED CAM MILLING SERVICE, JIG BORING, SPOT WELDING, CONTRACT PRODUCTION

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Lengths ¼" to 3"
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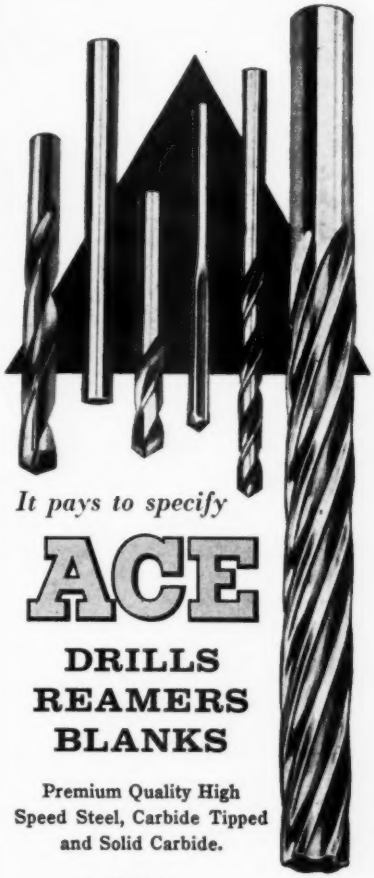

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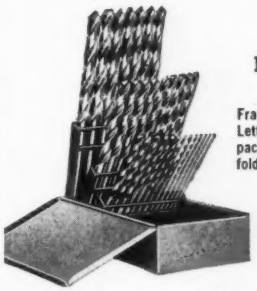

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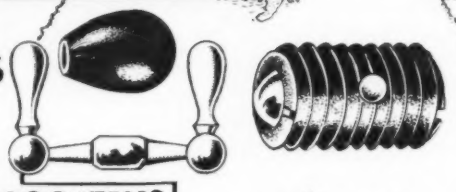

This complete tool room catalog lists everything you may need to give your tool room top efficiency. It lists many short cuts to speed up your production and improve the appearance of your product. It describes many new and ingenious items you will want to know about.

Here you will find a wide variety of handles, compression spring assortments, clamping levers, ball and spring plungers etc. etc.

Send for this free catalog today. Orders welcome for one to a thousand items.

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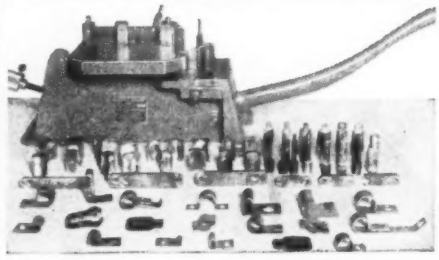

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Product News

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NOW . . . big machine quality in an economy priced compact band saw

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Would you like to make your metal cut-off jobs easier and more efficient? Would you like to be able to cut angles, slots, notches and bevels in the same machine?

You can do all of this with the new economical-to-buy and economical-to-use Wells Model 300 Metal Cutting Band Saw. Just check these features:

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- Well guarded—blade can be changed without removing guard
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Get full details on this remarkable value from your Wellsaw Representative or write for Bulletin No. 230.

61-1A

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for LATHES and GRINDERS

Center being used on grinder

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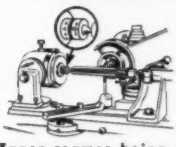
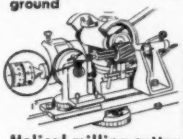


Taper reamer being ground



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- **permits TRUE work alignment from tailstock or headstock on: cylindrical grinders, cutter grinders, gear shavers, lathes and tracer attachments.**
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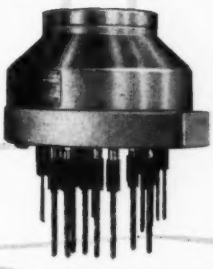
one head is better than more-if it's a ZAGAR Head for Drilling, Reaming and Tapping



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Zagar Standard Gearless Heads MAKE ANY NUMBER OF HOLES IN ANY PATTERN, IN ANY MATERIAL ON ALL CENTERS.

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make tool set ups easy!

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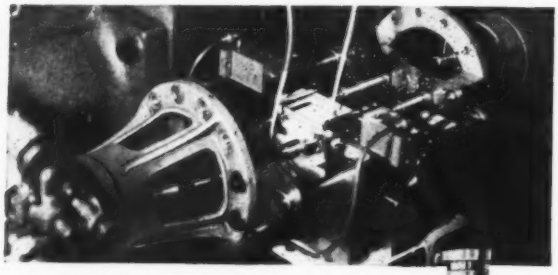
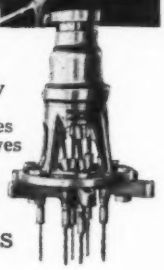
on the first job





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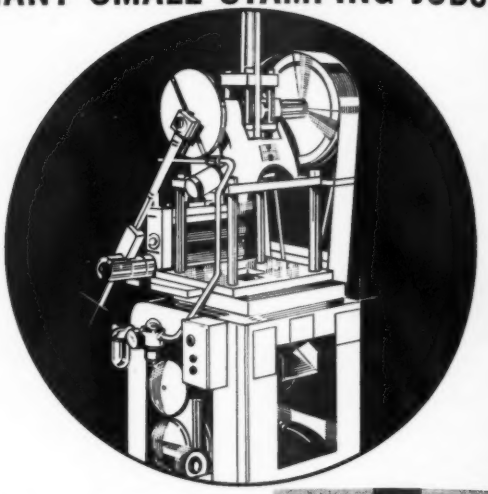

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Get longer die-life with exclusive cylindrical ram, bigger and better bearings, positive parallelism of ram and die. *Write for details.*

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Product News

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Star Stainless screws have clean—bright and shiny—heads

STAR STAINLESS SCREW CO.

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Telephone: CLifford 6-2300
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CORROSION RESISTANT

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The most VERSATILE... timesaving press in your shop

Dake Elec-Draulic Presses reduce production time in straightening pinion gears and broaching internal gear teeth for heavy-duty transmissions at the Fuller Manufacturing Company, Kalamazoo, Michigan. Dake Elec-Draulic Presses are used exclusively for the straightening operation because of their infinite control and greater straightening accuracy which reduce over-all straightening time.

For every type of press application, Dake Elec-Draulic Presses provide the same dependable time-saving operation. Their extreme versatility makes them ideally suited for every type of straightening, forming, bending, broaching, cold riveting, and press fit assembly. Standard models are available from 25 tons to 150 tons.

Send for copy of Catalog No. 350A.

DAKE PRESSES

DAKE CORPORATION

634 Robbins Road, Grand Haven, Michigan

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HARDENED and GROUND HSS BLANKS

Any decimal diameter — any length. Mirror finish surface to gage tolerance.

Many uses —

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53 Brown Ave., Springfield N. J.

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PDC
"AUTOMATIC"
CIRCULAR ASSEMBLY MACHINE

DIAMETERS
48"
60"
72"
84"
96"
Number of stations to suit your requirements.

YOUR CHOICE
- Electric Motor Drive
- Fluid Motor Drive
- Rotary Air Motor Drive

THE HEART OF YOUR SPECIAL MACHINE

Can be used for assembly of pumps, motors, or any assembly requiring a combination of hand-loaded and hopper-fed parts for pressing, spinning, screwdriving, etc.

Write TODAY
for new Catalog 60, for designers and engineers

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America's largest selection of economically priced PRESS ROOM EQUIPMENT

Durant
TOOL COMPANY
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DOUBLE STOCK REELS from $395.00

Motor Driven Stock Straighteners, 13 Models from $682.

Write for new, free catalog detailing a complete selection of Die Set Pullers, Roll Feeds, Punch Holders, Wire Straighteners, and Standard Stock Straigheners . . . Over 100 necessary pieces of equipment for the modern press room.

Our nearby representatives will be pleased to be of service to you without obligation.

STOCK OILERS, 5 Models from $41.80

Motor Driven Scrap Choppers, 4 Models from $235.

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DYKEM
STEEL BLUE
Stops Losses
making Dies and Templates

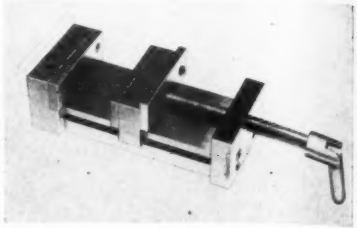
Popular package 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead
THE DYKEM COMPANY
2303L North 11th St. • St. Louis 6, Mo.

CIRCLE INFORM-A-GRAM KEY NO. 1163

Product News

Opens Wide



A new precision toolmakers vise handles a wide variety of sizes of workpieces due to its removable hardened and ground jaws with inside and outside jaw positions. The jaws opens 6" and is 3" wide. The unit is hardened and ground to 0.0002 in parallelism. The swivel-tail handle swings out of the way when the vise is in use, provides easy tightening when used in close quarters. For complete information write to Bald Eagle Products Co., 60 East 4th St., St. Paul 1, Minn., or mark Inform-A-Gram No. P31.

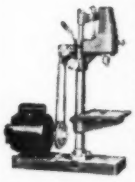
For HIGH SPEED
DRILLING
Precision and Sensitive

High Speed Model R-53

Built for precision, sensitive drilling, from No. 80 to ¼" diameter drills. Spindle and chuck indicated and guaranteed to .00075". Drills to center of 6" circle, spindle travel 2¼". Speeds 750, 1500, 3000 and 6000. Accurate, adjustable depth gauges. Bench or pedestal type. Also in multiple spindle units—with two to six individually motor driven spindles.

High Speed Model AF-7B

Built for precision drilling from No. 0 to 5/16" diameter drills. Drills to the center of an 11¾" circle. Vertical travel ahead — 8". Spindle travel — 2¾". Speeds 750, 1500, 3000, 6000 RPM. Spindle chuck indicated and guaranteed to .00075".



High Speed Model "U.S."

Built for precision drilling from No. 80 to ¼" diameter drills. Drills to the center of a 6" circle. Spindle feed 2¼". Maximum distances chuck to base—14". Available with two drives to give either 2450, 2815, 3080, 3540, or 2450, 3630, 4810 and 6000 RPM. Spindle and chuck indicated and guaranteed to .00075".

All these machines built in accordance with U. S. Government Specification OO-D-676a.

High Speed Hammer Co., Inc.
307 Norton St. Rochester 21, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 1164

TRUE

You may not get a "bargain price" on Barber-Colman cutters. But you always get a good buy. True cutter cost must include sharpening, scrap, tool-change down-time, and inventory. These can add up to eight times the cost of tool replacement. Just a little more tool life, toughness, or uniformity can prevent major additions to cost. Thrift, then, is really a question of quality. So buy the best—from your Barber-Colman distributor.

COST

BARBER COLMAN

BARBER-COLMAN COMPANY 97 Loomis Street, Rockford, Ill.

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KNOW *Your Sheet Metal Capabilities—*

Check it with this Ductility Tester

This highly sensitive sheet metal tester takes specimens up to 3/16" thick, applies up to 30,000 lbs. pressure. The completely enclosed hydraulic system is directly driven by an electric motor. Both one and two gauge models are made.

By turning one control, this machine grips the specimen, tests it, and releases it. Gripping pressure increases in proportion to test pressure. The test is made in full view and the results are read from the gauges' maximum indicator needles.

Write today for more information on ductility testing

DETROIT TESTING MACHINE COMPANY

9386 Grinnell Avenue, Detroit 13, Michigan

CIRCLE INFORM-A-GRAM KEY NO. 1172

template assembly can be so simple

with PEM Self-Clinching Drill Bushings

And so much less costly, too.

One-hole compression-mounting positively locks one or several bushings into template metal—in one operation.

No riveting, welding, indexing, nesting—no outboard supports needed.

High torque and pull-out resistance.

Permit thin-gauge, lightweight templates.

Save their cost in simplified assembly.

Write for literature and samples for test.

PEM

PENN ENGINEERING & MANUFACTURING CORP.
DOYLESTOWN, PENNSYLVANIA

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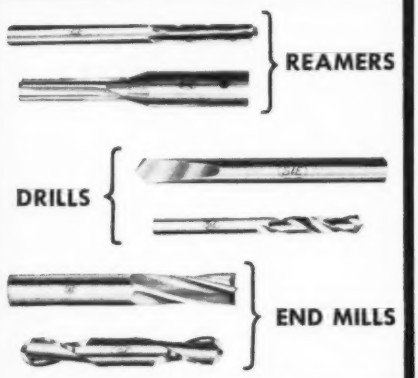
PRECISION CUTTING ... QUICK AND EASY with S&E SOLID CARBIDE TOOLS



S&E production cutting tools are ground from solid tungsten carbide to exact tolerances, concentric and with polished flutes.

These precision cutting tools are designed and built for one purpose: to cut fast, clean and easy; to hold size and form for extensive production runs; thus to yield lower cost tooling and higher production standards, and they do just that. Try S&E cutting tools—you will always be glad you did.

S&E are regularly fabricating special and unusual type cutting tools. Send drawings or request information—no obligation of course.

Complete catalog of S&E tools available on request.

S&E MACHINE PRODUCTS INC.

Bridgeport, Michigan
Sales offices in all principal cities.

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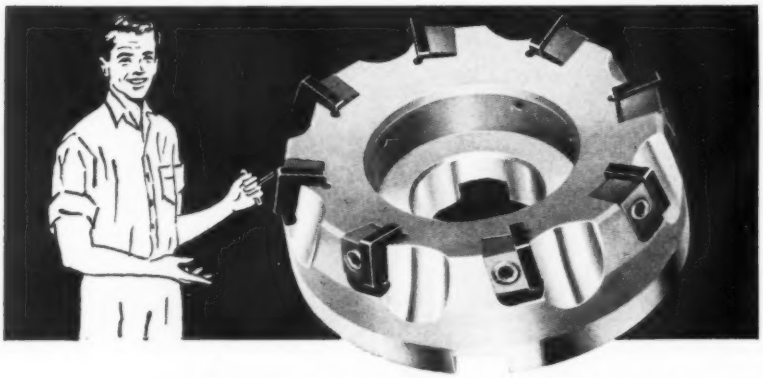

just INDEX in a minute and MILL for a dollar with FUTURMILL

This six inch—eight station Futurmill (Model ZN3L) mills like a new cutter every time you index the blades. Eight brand new solid carbide cutting edges ready to go . . . in one minute . . . cost is one dollar.

Consider your costs for grinding wheels, grinding machines, labor, overhead, machine and production down time, can you grind your present cutters sharp—in one minute ? ? ? . . . and for one dollar ? ? ?

For information or new cutter catalog no. 606 write

Futurmill inc. 6360 Highland Road Pontiac, Michigan

In Canada: Futurmill (Canada) Ltd. PO Box 95, Dundas, Ont.

CIRCLE INFORM-A-GRAM KEY NO. 1182

AUTOMATICALLY

The Model 90FS Universal Automatic Flute Grinder

MAKES TOOLS With Straight or Spiral Flutes IN MINUTES

Saves Money Because

FLUTED TOOLS Cutters • Millers • Taps • Reamers

MADE AUTOMATICALLY are Economical

Get details on Miller and Grinder

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WALLS TU-WAY BELT SANDER

USE IT EITHER WAY

Full 1/3 h.p. G. E. Motor

At last, a top quality industrial sander that provides all the most wanted features — yet sells for so little.

complete with cord, plug, switch ready to use $89.95

Work table in vert. illus. optional.

Illustrated Literature on Request

A few desirable distributor territories still available.

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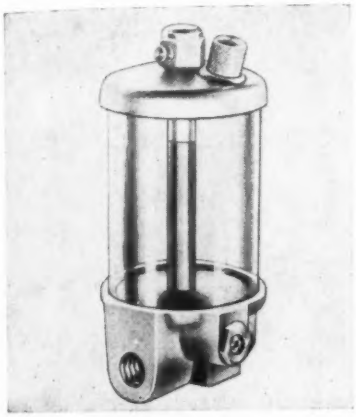
CIRCLE INFORM-A-GRAM KEY NO. 1184

Product News

Automatic Air Lubricator

Better distribution of the lubricant to all working parts of pneumatic tools is assured with the new PSC air lubricator. This principle delivers the lubricant to the downstream line in the form of a suspended, fog-like oily mist. Air enters the plastic oil reservoir through the center tube, equalizing



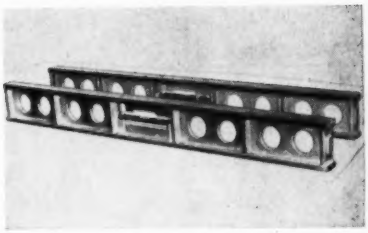
pressures in the oil chamber and the air line. The exact amount of oil is metered by setting the external oil adjustment valve. The lubricators are available from Perfecting Service Co., 332 Atando Ave., Charlotte 6, N.C. in ¼, ⅜, ½ and ¾" NPT pipe sizes. Inform-A-Gram No. P32.

Dry-Film Lubricant

Molykote X-15 an inorganic-bonded, dry film lubricant has a useful temperature range of from −300 to +1200°F. The extreme-environment lubricant is insensitive to liquid oxygen, unaffected by up to 5 x 10^6 roentgen gamma radiation. It retains lubricating properties under vacuums up to 10^{-9} mm of Hg, and is easy to apply in either shop or field. Molykote X-15 can be applied by brushing or spraying. It air dries to a tough, resilient coating in one hour at room temperature. Additional information from The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn., or Inform-A-Gram No. P33.

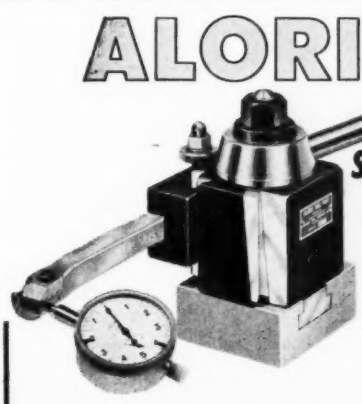
On the Level

A new kind of parallel straight edge, with a built-in level, permits simultaneous checking of both levelness and accuracy of a machine bed. It can also be used for positioning work above and parallel to the surface plate when checking or scribing parts. The units are available from Challenge Machinery Co., Grand Haven, Mich., in lightweight aluminum and standard semi-steel. Working

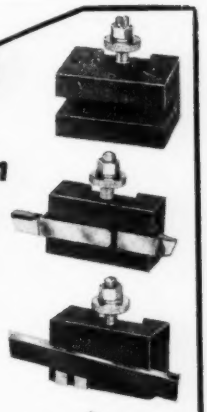


surfaces on both are precision ground flat and parallel to within 0.0005 overall. The maker will supply more information, or circle Inform-A-Gram No. P34.

ALORIS



Super Precision quick-change Tool Post and Tool Holders



.0001" REPEATING ACCURACY

Speeds all lathe operations

"no lathe owner can afford to be without it"

Aloris leads the way with advanced developments in "quick-change" tooling . . . recommended by America's leading lathe manufacturers.

- Modernize your lathe operations for maximum efficiency.
- .0001" repeating accuracy maintained even when deep boring.
- Patented tapered sliding Gib tool post, pulling in on the holder provides positive lock.

- CHANGE TOOLS IN SECONDS
- NO TIME WASTED WITH SHIMS
- ABSOLUTE RIGIDITY — NO CHATTER OR VIBRATION
- UNLIMITED VERSATILITY
- COMPLETE SATISFACTION GUARANTEED

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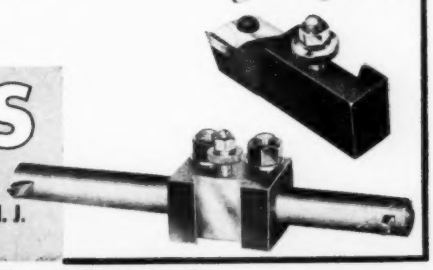
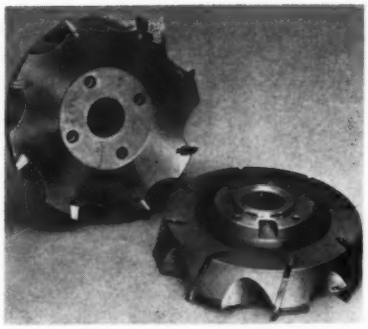


CIRCLE INFORM-A-GRAM KEY NO. 119

Product News

Special Cutter

A special Rigidcut inserted-blade face mill, designed for a manufacturer of aluminum auto parts by Wesson Corp., 1220 Woodward Heights Blvd., Ferndale 20, Mich., permits operation of a center-column indexing machine at top production. The cutter rough mills a 7" long part in 9 sec and

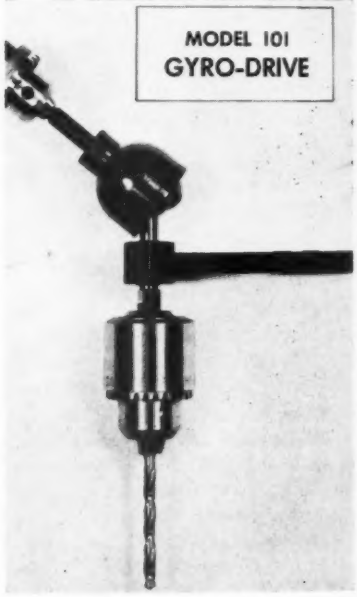


holds surface flatness under 0.0005. It produces a surface finish well below 100 rms. Cutting speed of this 8.24 die cutter is 7776 sfpm with a feed rate of 158 ipm. The eight inserted blades are tipped with Wessonmetal grade GI carbide. Design of the cutter makes use of centrifugal force to deliver coolant where it is needed. Write the maker, or mark Inform-A-Gram No. P35.

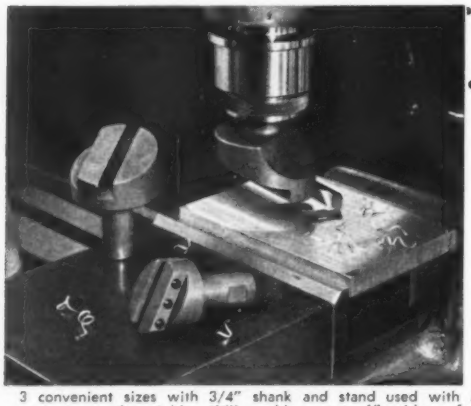
The Inform-A-Gram Card, which follows page 82 in this issue, is for your convenience in making inquiries about Advertised Products and Editorial articles.

Bantam Converter

Model 101 Gryo-Drive, a 12 oz., 6" bantam, converts any power drill into a variable angle tool, drills in cramped quarters and reaches around corners. It fits all ½ and ¼" power drills, and works at full power without a bulky gearbox. It can also be mounted directly into any drill spindle with ⅜ x



24" male or female thread. Model 201 Gryo-Drive works on impact and socket wrenches, ⅜ or ½" drive. More information from Glenwood Gyro-Drive, Inc., Glenwood, Minn., or circle Inform-A-Gram No. P36.



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New - Improved
FLY-TOOL
CUTTER HOLDER

$39.50 SET OF 3

3 convenient sizes with 3/4" shank and stand used with 5/16" carbide or high speed tool bits. Will machine up to 6" wide surface.
NEW counterbalanced model allows faster speeds and feeds. Made of steel-hardened. Save on expensive end mills and sharpening cost. Better finishes. Write for Bulletin.
BUY FROM YOUR DEALER

CITY TOOL DIE & MFG. CO., INC.
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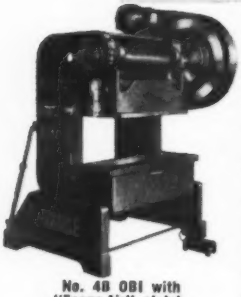
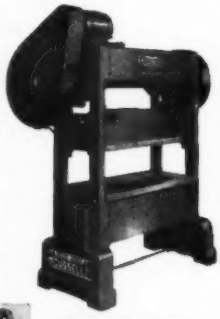
CIRCLE INFORM-A-GRAM KEY NO. 1201

High-Output with ROUSSELLE
DOUBLE-CRANK PRESSES



No. 4B OBI with "Econo-Air" clutch.

SPEED UP PRODUCTION with these versatile 40-ton presses. Large bed and ram areas make them ideally suited to handle wide rolls or sheets . . . do multiple punching, steel-rule die work and other high output operations. For rapid, shockless starting and stopping, presses can be equipped with electrically controlled "Econo-Air" friction clutch . . . Ask for new catalog.



Choice of over 30 models and types in 5 to 60-ton sizes

STRAIGHT SIDE – Die space up to 24 in.; bed space up to 6 ft. between uprights.

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Mfrs. of Rousselle Presses
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Rousselle Presses are sold exclusively through Leading Machinery Dealers.

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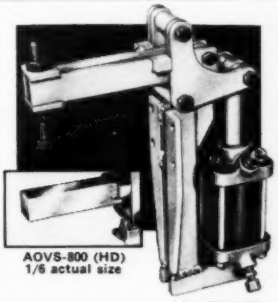

AOVS-800 (HD) 1/6 actual size

AOV-800 (HD) 1/6 actual size

DON'T SEND A BOY TO DO A MAN'S JOB — SPECIFY *KNU-VISE* NEW *VERTICAL CYLINDER* CLAMPS

Tough, rugged and designed to do a man-sized clamping job — that's the *new* line of *vertical cylinder* air or oil operated clamps now being manufactured by Lapeer Knu-Vise.

The all new Heavy Duty AOV Series, features three basic sizes of 200, 400 and 800 lbs. clamping force respectively. Each size may be specified with either solid (inset) or channel toggle bars and spindle assembly (top).

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Manufacturers of over 150 models of manually and air-operated clamps and pliers

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DEKA•DRILL is an automatic cycle hydraulically powered 14 spindle drilling and tapping machine that saves you time and money NOW. Costs 50% less . . . cuts set-up time in half . . . makes smaller runs profitable. Comparable in performance to any machine of its type. Suited for conventional or automated type jigs and fixtures. Component parts rated 20% to 25% beyond capacity. Free time and process studies available on request.

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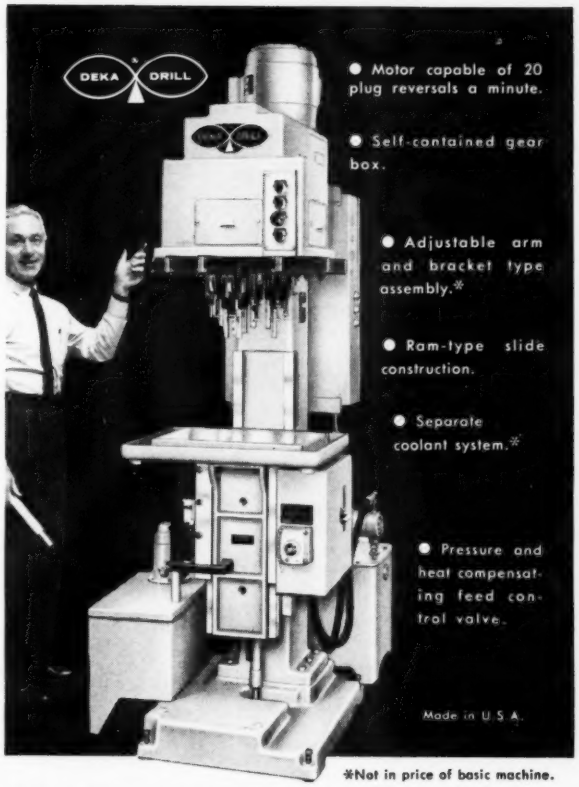
DEKA DRILL
● Motor capable of 20 plug reversals a minute.
● Self-contained gear box.
● Adjustable arm and bracket type assembly.*
● Ram-type slide construction.
● Separate coolant system.*
● Pressure and heat compensating feed control valve.
Made in U.S.A.

*Not in price of basic machine.

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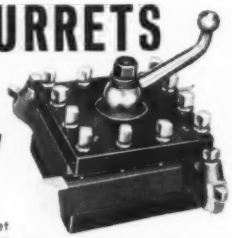
Enco TOOL POST TURRETS ±.0005"

Re-Indexing Accuracy Guaranteed!

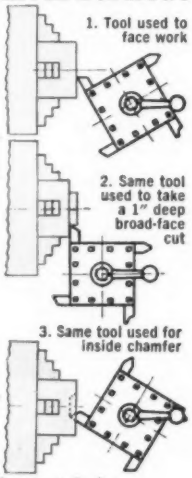


Put an Enco Turret on your lathe and get the accuracy, speed, and cost-cutting advantages that make Enco Turrets first choice of leading lathe builders. Get 12 station indexing—30°, 60°, and 90° from each of 4 tools . . . get smooth, effortless hand indexing . . . and capitalize on the advantages of Enco's exclusive, patented "O" Ring Seal that keeps indexing mechanism free of chips and dirt. There's an Enco Turret made to fit your lathe.

TOOL SIZE	TOOL BLOCK SPECIFICATIONS	PRICES F.O.B. CHICAGO
	(STANDARD)	
⅛"- ⅜"	2½" sq. x 1¼" thick	$ 39.00
⅜"- ½"	3½" sq. x 1¾" thick	$ 61.00
½"- ⅝"	3½" sq. x 2¼" thick	$ 76.00
⅝"- ¾"	4½" sq. x 2¼" thick	$ 83.00
¾"-1"	4½" sq. x 2¾" thick	$102.00
1"-1¼"	6" sq. x 3¼" thick	$175.00
	(HEAVY-DUTY)	
¾"-1"	4½" sq. x 3" thick	$155.00
1" -1½"	6½" sq. x 3¾" thick	$225.00
1¼"-1¾"	7" sq. x 4¼" thick	$265.00
1½"-2"	7½" sq. x 4¾" thick	$305.00

Machineable Base T-Slot Turrets carried in stock.
To order Turret fitted to your lathe, send T-Slot, center height dimensions and maximum tool size. No charge for fitting. Fast Delivery.

Makes 1 tool do the work of 3



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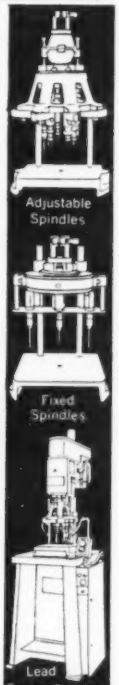

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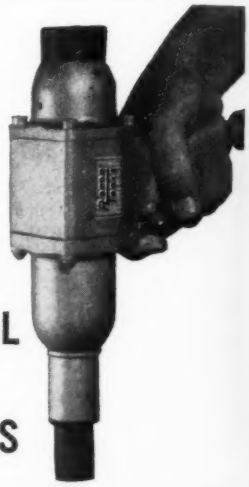

Rotor announces J-42T torque control air impact wrench with new hydraulic amplifier

● **NEW** unique hydraulic amplifier shuts off tool at desired torque. This exclusive device results in... ● **FASTER** rundown and impacting speed. Cuts job time. ● **MORE ACCURATE** torque control with uniform results. Quick, easy adjustment ...tamperproof. ● **ASK FOR DEMONSTRATION** of the J-42T to see how this outstanding development can cut costs on your assembly line. Write The Rotor Tool Co., 26341 Lakeland Blvd., Cleveland 32, Ohio. Subsidiary of The Cooper-Bessemer Corp.

ROTOR TOOLS

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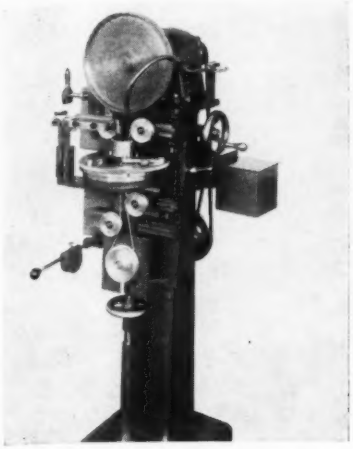
Shining Dies



A new die polishing machine offers savings in polishing nearly all styles of dies. The unit features an endless abrasive belt driven at 5000 rpm to polish the die parallel to the line of draw. An angle polishing fixture accurately maintains die manufacturers' specifications on approach, back relief angles and bearing sizes. Parker-Hartford Corp., Hartford, Conn., states the unit is suitable for polishing new dies or for reworking worn ones. Write, or circle No. P37.

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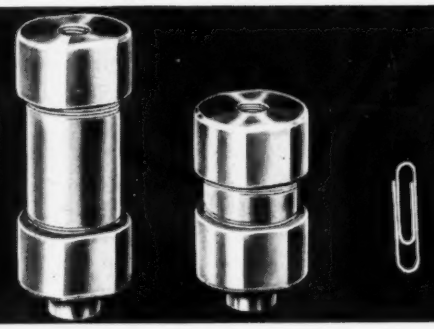
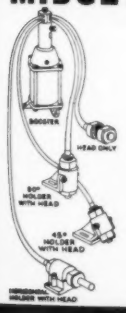


with Wilton's NEW
MIDGET air-hydraulic PowRlock!



Holding problem in a machine operation where clearances are critical? The new Midget PowRlock is your answer. Although the Midget is smaller than a pack of cigarettes, it develops holding forces up to 1900 pounds! Securely holds and positions regular or irregular pieces. Four 1" or eight ½" stroke heads may be operated from a single booster.

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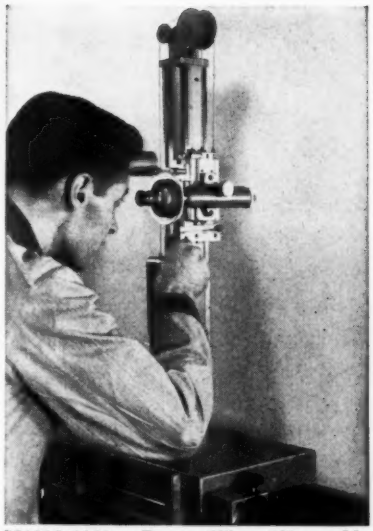

M1238-1818 — *Range 18" x 18", working distance 9" to infinity. Reads to 0.001" up to 24" working distance. Protractor ocular reads to 3 minutes of arc. Image is erect.*

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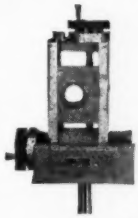
M1236-46— → Horizontal range 6", vertical range 4", Reads to 0.0001", working distance 5" to infinity.



← M1236-22— Range 2" x 2", reads to 0.0001". Working distance 5" to infinity. Shown with 19 mm mounting rod, and without telemicroscope. Instrument permits precise coordinate movement of other objects such as photo cells, probes, etc., in place of telemicroscope.

Write for Bulletin 188-53

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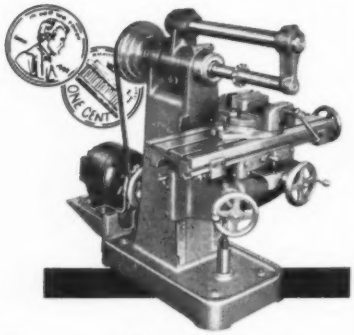

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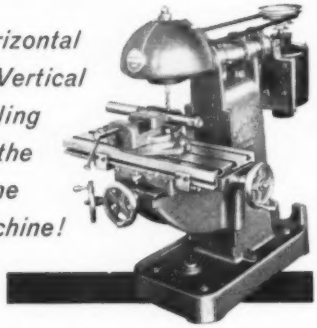

Benchmaster answered two basic metal-working questions in this famous milling machine—*Why spend money on a big mill for small jobs?* and *Why buy separate horizontal and vertical mills when a Benchmaster can do both jobs?*

Benchmaster spindle assemblies are rapidly interchangeable. Simply slide one out and replace with the other. The vertical head rotates to any position in the vertical plane. When both horizontal and vertical milling are advantageous on the same job, just switch spindle assemblies *without destroying the set-up!*

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CIRCLE INFORM-A-GRAM KEY NO. 1241

Turret Drill . . . fewer machines

Security Valve Co. (a division of Menasco Manufacturing Co.) Pasadena, Calif., has effected a production increase of 125%, and saved $6,500/yr. This impressive efficiency rise was accomplished by applying one Burgmaster Model 25 AH turret drilling machine to the machining of bodies for just two sizes of Security's broad line of many kinds of valves.

Heretofore seven machines were required to complete the machining of this cast iron part. Using the Burgmaster only two other machines are required, and this is how it's done:

Bonnets of valve bodies are machined on a turret lathe. Body bolt holes are then produced by a radial drill. The part is then positioned on the Burgmaster, in a special air-actuated holding fixture, and its side is cross-drilled and tapped. Tools used are: a 29/32" core drill; carbide step reamer; a 1" bore Burgmaster Positive Drive 7/8-14 tapper; and a Burgmaster Lead Screw Tapper.

Likely that such modernization could turn similar profits somewhere in your operation. To find out, write Burgmaster Corp., 15001 S. Figueroa St., Gardena, Calif., or circle Inform-A-Gram No. D4.

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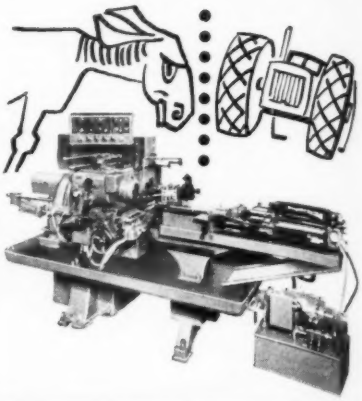

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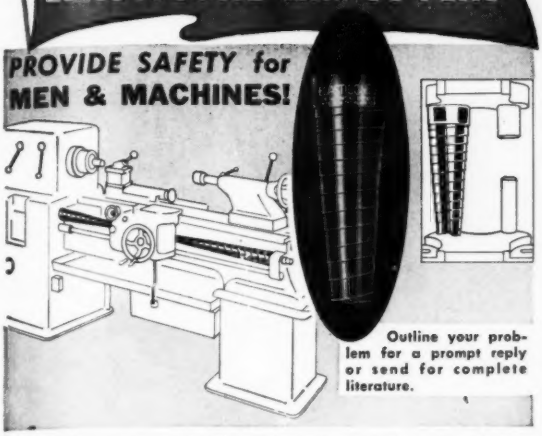

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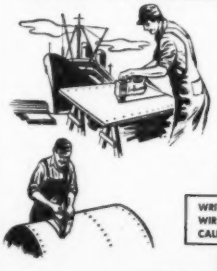

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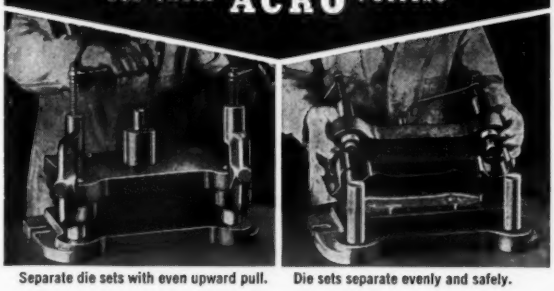

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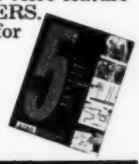

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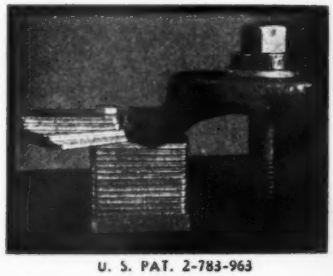

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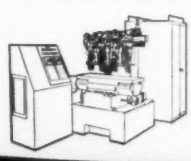

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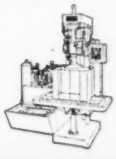

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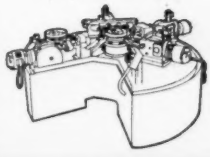

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DELIVERY FROM STOCK

SPECIAL RH & LH
HIGH SPEED

TAPS • DIES • THREAD PLUG & RING GAGES

NEW SIZES ADDED DAILY . . . IF NOT LISTED— WRITE

DEALER INQUIRIES INVITED

WHEN REQUESTING QUOTATIONS ALWAYS MENTION QUANTITIES

SIZE	THREADS PER INCH
0000	160
000	120
00	90-96-112
0	56-64-72-80-90
1	48-56-60-64-80-90
2	48-52-54-56-60-72-80-96
3	36-40-60-64-72-80
4	30-32-38-42-44-56-60-64-72-80-90
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3-7/16	4-8-10-12-16
3-5/8	4-8-10-12-16
3-3/4	4-8-10-12-16
3-7/8	4-8-10-12-16
4	4-6-8-10-12-16
4-1/8	4-8-10-12-16
4-1/4	4-8-10-12-16

Many more sizes in stock up to 6" dia.

LEFT HAND N.C. (USS)—N.F. (SAE) SIZES

SEE ABOVE SECTION FOR MORE SIZES

SIZE	THREADS	SIZE	THREADS	SIZE	THREADS	SIZE	THREADS
0	80	8	32-36	7/16	14-20	1"	8-12-14
1	64-72	10	24-32	1/2	13-20	1-1/8	7-12
2	56-64	12	24-28	9/16	12-18	1-1/4	7-12
3	48-56	14	20-24	5/8	11-18	1-5/16	6-12
4	36-40-48	1/4	20-28	11/16	11-16	1-3/8	6-12
5	40-44	5/16	18-24	3/4	10-16	1-7/16	6-12
6	32-40	3/8	16-24	7/8	9-14	1-1/2	6-12

'OVERSIZE' and 'UNDERSIZE' TAPS

RIGHT AND LEFT HAND N.C. AND N.F. SIZES

MACHINE SCREW	#2 to #5	Plus or Minus .002, .003, .005
MACHINE SCREW	#6 to #14	Plus or Minus .003, .005, .010
FRACTIONAL	1/4" to 1-1/2"	Plus or Minus .003, .005, .010 .015, 1/64, 1/32

Right & Left Hand—Unlisted 'Gun' or Spiral Pointed Taps

Size	Threads	Size	Threads
0	80 NF		
1	56 NS	7/8	9 NC, 14 NF
2	56 NC, 64 NF	1	8 NC, 12-14 NF
9/16	12 NC, 18 NC	1-1/8	7 NC, 12 NF
5/8	11 NC, 18 NF	1-1/4	7 NC, 12 NF
11/16	11 NS, 16 NS	1-3/8	6 NC, 12 NF
3/4	10 NC, 16 NF	1-1/2	6 NC, 12 NF

Right Hand—Unlisted 'Pulley' And Extra Length Taps

Size	Threads	Size	Threads
4	36-40 NC, 48 NF	3/8	24 NF
5	40 NC, 44 NF	7/16	20 NF
6	32 NC, 40 NF	1/2	20 NF
8	32 NC, 36 NF	9/16	12 NC
10	24 NC, 32 NF	9/16	18 NF
12	24 NC, 28 NF	5/8	18 NF
1/4	28 NF	3/4	16 NF
5/16	24 NF	Also Larger Sizes	NC & NF

UNLISTED Right Hand "Pipe" Taps

"NPT" Taper "NPT" Size	Thread	"NPS" Size	Thread	EX. LENGTH "NPT" & "NPS" Size	Thread
		1/16	27	1	8
1/16	27	1-1/4	11½	1/16	27
1/4	27	1-1/2	11½	1/8	27
2-1/2	8	2	11½	1/4	18
3	8	2-1/2	8	3/8	18
3-1/2	8	3	8	1/2	14
4	8	3-1/2	8	3/4	14
Also British		4	8	1	11½
		Also British			

Left Hand 'Pipe Taps' Taper and Straight

Size	Thread	Size	Thread
1/16	27	1	11½
1/8	27	1-1/4	11½
1/4	18	1-1/2	11½
3/8	18	2	11½
1/2	14	2-1/2	8
3/4	14	3	8
Also British		3-1/2	8
		Also British	

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☑ PRICE

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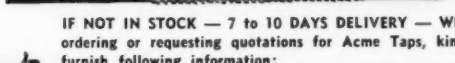

IF NOT IN STOCK — 7 to 10 DAYS DELIVERY — When ordering or requesting quotations for Acme Taps, kindly furnish following information:

(a) Kind of material being machined. (b) Depth of hole in inches, through or bottom hole. (c) Tap to be used horizontally or vertically. (d) Will tap turn, or is piece expected to be turned. (e) Is tapping job expected to be done in one pass. (f) Would tap be backed out of hole, or machine stopped for release of tap. (g) If possible, submit thread length, and overall length of tap desired with blue print.

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Industrial Cutting Tools

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